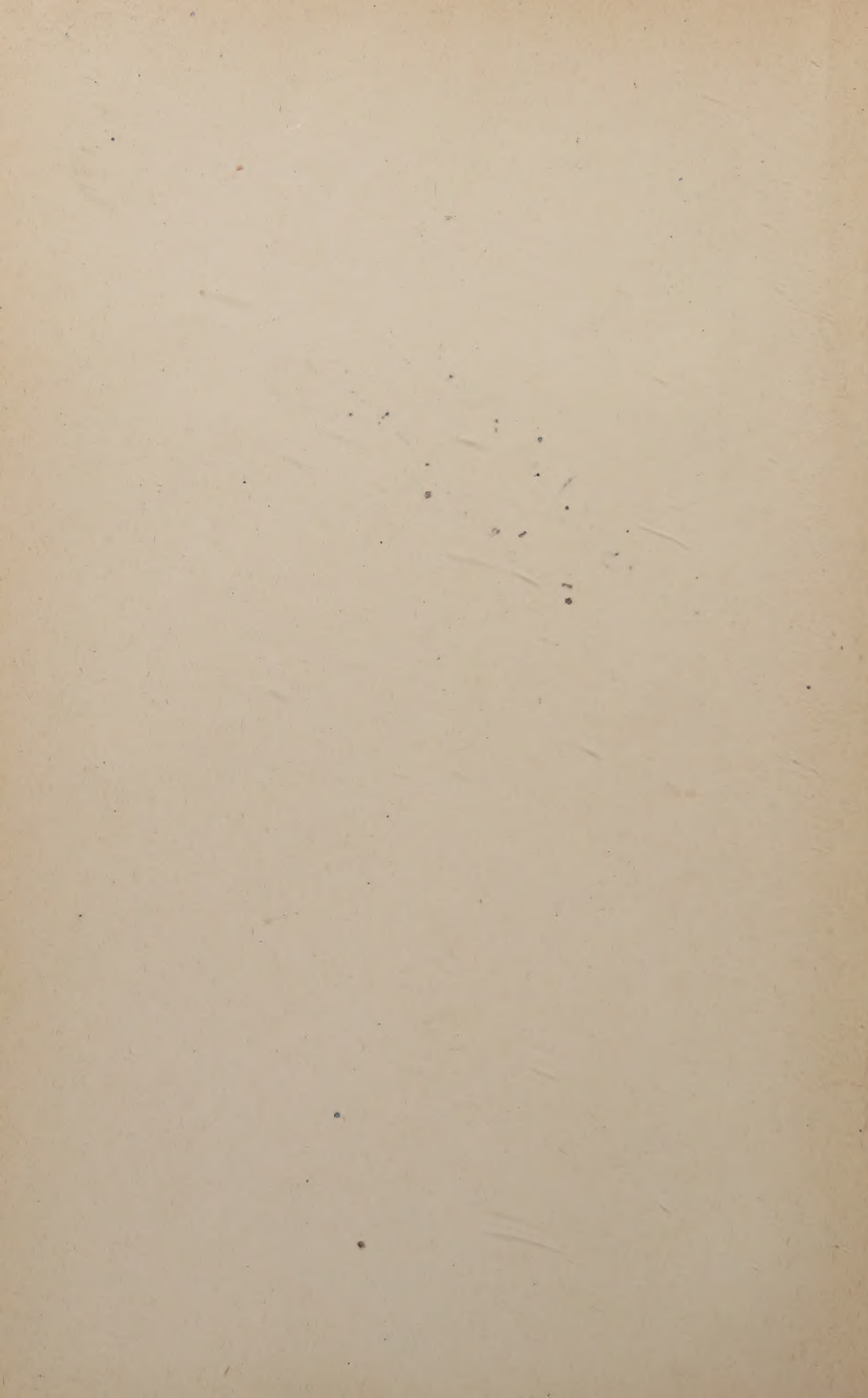




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Prosthetic Dentistry

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Illustrations

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PREFACE.

In revising and placing in the hands of the students of the Northwestern University Dental School the printed lectures of the session of 1900-1 an effort has been made to introduce some of the more recent methods of practice, particularly in porcelain work. The recent fire, which so seriously damaged the University Building, also destroyed most of the revised manuscript, on which much labor had been expended. The lack of necessary time, therefore, accounts for the presence of a considerable amount of the subject matter as it appeared in the first edition.

In this edition the numbered paragraph has been introduced, which, in conjunction with the quiz questions appended, and which are also numbered, will, it is hoped, insure uniformity and thoroughness in the quiz work in the several classes and encourage the student to greater efforts in this subject.

This edition is issued for the use of the students in the Dental School and not for general distribution. The physical properties of the metals, composition of solders and alloys of various kinds, soldering, welding, tempering and various other subjects of vital importance to the prosthetic dentist are given in the regular course of lectures, but have not been included in the subjects here presented, and, therefore, to one not familiar with the didactic work of the school this edition would seem deficient in many important particulars.

The writer is deeply indebted to the S. S. White Dental Manufacturing Company for many of the cuts used in illustrating the various subjects; also to H. D. Justi & Son, the Consolidated Dental Manufacturing Company, Ransom & Randolph, Lee Smith & Co., the Griswold Dental Bridge Company, the Turner Brass Works and to Dr. Condit for the use of cuts illustrating the appliances bearing his name.

It is hoped that this edition may be of more assistance to the student than the former one, in acquiring that knowledge and dexterity which is essential to success in practice. J. H. P.

Chicago, March 1, 1904.

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CHAPTER I.

Prosthetic Dentistry.

1. Prosthetic dentistry is that branch of dental science which treats of the various methods of replacing the lost organs of the mouth in whole or in part, the artistic and mechanical processes involved in such restorations, together with a description of the physical properties and peculiarities of the various materials employed.

2. More specifically considered, prosthetic operations may be classed as follows: Construction of crowns, bridges and dentures, obturators and appliances for correcting defects of the palate, appliances for correcting irregularities of the teeth and jaws, appliances for retaining in position fractured bones of the face when reduced and the construction of metallic and porcelain inlay fillings.

3. To fulfill, successfully, and in the highest and broadest sense, the vocation of a prosthetic dentist one must have—

First—A clear conception of the best methods of correcting and restoring the partial or complete loss of the organs of mastication and speech from the standpoint of both durability and esthetic requirements as included in the subject of prosthetic as well as operative dentistry.

Second—The necessary skill or handcraft to construct and carry out, in the minutest details, the most difficult as well as the more simple classes of restorations and substitutes as included in the subject of prosthetic technics.

Third—An intimate knowledge of the physical and chemical properties and peculiarities of the various materials employed as included in the subjects of physics, chemistry and metallurgy.

4. The degree of success attained by the student or practitioner will be proportional to the thoroughness exercised in the pursuit of these various studies and in the acquirement of a high order of technical skill and manipulative ability. In

supplying substitutes for the natural teeth two problems present themselves to the prosthetist.

5. The first consideration consists in restoring as fully as possible the function of mastication. When from any cause this function is interfered with or impaired, the digestive organs are necessarily required to do an extra amount of work for which they are unfitted, and which will eventually result in impaired digestion, systemic disturbances and general ill-health of a more or less serious character. Too much stress, therefore, cannot be laid upon this fact, and in constructing substitutes for the natural teeth they should be made to restore as fully as possible the lost function of mastication, since this is really of first importance to the patient.

6. The second consideration is one which ranks next to utility, and is also of great importance, viz.: A regard for esthetic requirements.

G. H. Lewes, in "Problems of Life and Mind," says: "Beauty, if it does not take precedence of utility, is certainly coeval with it; and when the first animal wants are satisfied the esthetic desires seek their gratification."

7. The prosthetic dentist should be a true artist and such a master of his art that he can, at will, imitate nature in her ideal as well as less typical forms and moods, according to conditions required in each case.

From the nature of his vocation he should be an anatomist, a sculptor, an artist and an artisan, capable, thorough and proficient in each line mentioned, in order to fulfill in the highest degree the requirements imposed upon him by his profession.

8. In entering upon the study of dentistry the student should understand and thoroughly appreciate the fact that the vocation of a dentist is not that of a mere trade, but a scientific profession of the highest importance, and that the thorough and conscientious dentist is not a tradesman nor an ordinary mechanic. He is a scientific specialist, who is constantly called upon to treat living, sensitive, vital tissue, to arrest the diseases occurring in the mouth and to restore as far as may be practicable by artificial means the tissues that may have been lost by accident or disease. The mouth is one of the most prominent features of the face, and attracts as much attention as the eyes.

9. An eminent writer on facial expression once said: "If the eyes are the most expressive part of the face, the mouth is the most sympathetic." Herder, the eminent German poet and critic, said of this most prominent feature of the face: "It is from the mouth that the voice issues, interpreter of the heart and soul, expression of feeling, of friendship and of the purest enthusiasm. The upper lip translates the inclinations, the appetite, the disquietude of love; pride and passion contract it; cunning attenuates it; goodness of heart reflects it; debauchery enervates and debases it; love and the passions incarnate themselves there in an inexpressible charm."

Lavater, one of the early writers on physiognomy, says, in speaking of the mouth: "I conjure our painters and every artist whose mission it is to represent man. I conjure them with all my might to study the most precious of all our organs, in all its varieties, in all its proportions and in all its harmonies."

10. When closed, the lips are the noticeable points of interest of the mouth, but in laughing or speaking the teeth become the most noticeable features, because they are brought more or less prominently into view. When clean, perfect, symmetrical and normally arranged they are priceless pearls of beauty. When decayed, irregular or lost by accident or disease, the symmetry of the face suffers in consequence. An eminent physician once said: "The most beautiful teeth are not enough to make a man beautiful, but ugly teeth would spoil the beauty of the Venus of Milo herself."

11. There is a wide range of variation as to size, color and arrangement of the teeth of different individuals, and at times the skill of the prosthetist will be taxed to the utmost to supply substitutes that will harmonize with the remaining natural teeth, if any be present, and in edentulous cases to construct dentures so true to nature in all particulars that when introduced in the mouth their artificiality cannot be detected.

The knowledge, skill and handcraft necessary to carry out the requirements mentioned come only with close, long-continued and patient application. The artistic and esthetic as well as the mechanical faculties should be encouraged and developed in the course of study laid down for the prosthetist,

for his success depends upon the thorough, harmonious and balanced development of all of these faculties.

12. When equipped by proper training and experience it is the privilege, the duty, and should be the ambition, of every member of the dental profession to instruct his patients in the best methods of caring for the natural teeth, to treat and preserve by operative procedure those susceptible to treatment by such methods and to restore with substitutes that harmonize with the natural teeth, such as cannot be saved by operative procedures.

CHAPTER II.

Artificial Dentures.

13. Prosthetic operations are divided into different classes, as previously stated, and in the following series of articles an effort will be made to present briefly, yet in all of the essential details, one or more methods of carrying out the various operations considered under the different headings, beginning with the simpler and proceeding to the more complicated procedures.

14. The construction of artificial dentures is perhaps the simplest class of operations included in the subject of Prosthetic Dentistry.

It would be misleading to say that the construction of dentures of any character which successfully restore the function of mastication and fulfill esthetic requirements is a simple operation. The finished, successful denture is the result of a series of steps following each other in logical sequence, each of which has been carried out with mathematical precision. Neglect in carrying out any one step as it should be done may result in failure to fulfill the required conditions. Therefore, it is necessary to understand the difficulties met with and the causes of failure in denture construction to be successful in this line of work.

The means by which artificial dentures are retained in position in the mouth, the causes of displacement and the steps for obviating or overcoming the same will be outlined before entering upon the construction details.

Retention of Artificial Dentures.

15. Full upper dentures are retained in position in the mouth principally by atmospheric pressure. The property known as adhesion, the force which holds together molecules of different kinds, together with the viscosity of the mucus, also assist in giving stability to dentures.

16. Full lower dentures are retained in position principally by gravity, although both atmospheric pressure and adhesion assist very materially in some instances. Usually the cheek and lip muscles on the outer surfaces and the tongue on the inner surfaces of the denture tend to give stability, although in some cases they become active causes of displacement.

17. Partial dentures are retained in position by means of the aids just mentioned, and in favorable cases by clasps or appliances which are attached to the base plates and so shaped as to firmly grasp some of the remaining natural teeth, in this manner giving firmness and stability to the substitutes.

Atmospheric Pressure.

18. In the study of physics the pressure of the atmosphere is demonstrated by exhausting the air from a bell jar or from between two plane or parallel contact surfaces. When perfectly excluded it will require a force a little greater than 14.7 pounds per square inch to separate the objects. The palatine portion of the mouth might be considered as one contact surface and the denture adapted to it as a corresponding surface. The tongue and cheek muscles act as an air pump and partially exhaust the air from between the contact surfaces. So long as the air is excluded pressure will be observable, but if from any cause the adaptation of the surfaces to each other is interfered with the air rushes in and the stability of the substitute is destroyed.

19. The most common cause of the displacement of dentures is due to the stress exerted by the muscles of mastication in closing the lower jaw, especially when the latter is thrown to one side or the other, bringing the lower teeth in partial occlusion or in suitable relation to the upper for masticating food. The reason for displacement occurring can be explained by reference to the relation of the artificial teeth to the alveolar process and the palatine portion of the denture.

20. The denture represents a lever of the first class, the alveolar border the fulcrum, the lingual surfaces or incisal ends of the anterior and the occlusal surfaces of the bicuspid and molars represent points to which power is applied, while the adhesion of the palatine portion of the denture to this sur-

face of the mouth represents the weight to be lifted or overcome before displacement can occur. (See Fig. 1.)

21. When the palatine portion and alveolar border of a mouth are of uniform density throughout and the adaptation of the denture is accurate, displacement will seldom occur. When, however, the parts to which the denture is adapted are

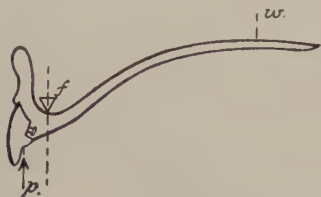


FIG. 1.

irregularly soft and hard, the liability to displacement is much greater, since in such cases some one of the hard or unyielding areas acts as a fulcrum on which the base plate will tip when force is applied to the margin of the denture because of the great distance, proportionately, of the power from the fulcrum.

To overcome this very decided and frequent difficulty the following method of procedure is recommended:

Relieving the Impression and Model.

22. Previous to taking an impression the mouth should be closely examined and all the conditions carefully noted, especial attention being directed to the location and extent of hard and soft areas. In most mouths there will be found a hard area, of greater or less extent, in the central or palatine portion, and, as before stated, it is on this surface that the greatest percentage of plates will rock, unless precautions are taken to prevent it.

The method that has perhaps proven the most satisfactory is to relieve the pressure of the plate over this area by trimming the impression before it is poured. Fig. 2a shows the most common location and outline of the hard surface. The impression is trimmed, as outlined, to a depth of one to one and a half millimeters, depending on the condition of the surrounding soft tissues. If these are very soft and yielding the trimming must be deep; if moderately firm, the relieved portion can be correspondingly shallow. The trimming should be

carried from two to three millimeters beyond the margins of the hard area, as outlined at *a*, so that the denture, when completed, will have very little, if any, bearing on this surface. The margins of the relieved portion should be carried out gradually, no angle, such as is usually formed in the ordinary vacuum chamber, being necessary to accomplish the object sought. It is not the idea to construct a vacuum chamber, but to relieve pressure only, so that a more perfect contact of the peripheral as well as of the general surfaces may be secured. If this is properly done a favorable fit is usually obtained. If only partial relief is afforded, it will result in failure. When the tissues covering the alveolar ridge are soft and flabby, it is

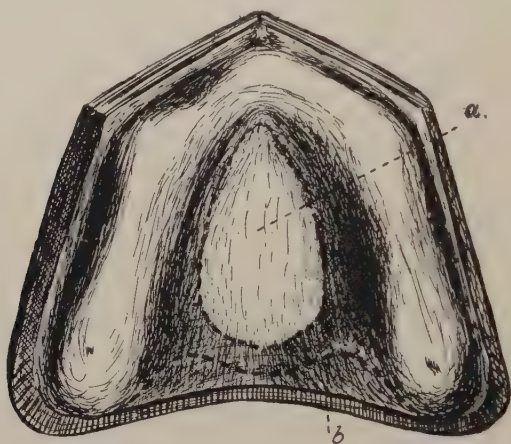


FIG. 2.

sometimes best to scrape these areas on the model so that the denture will compress them to a greater or less extent.

23. The general rule is to trim those surfaces corresponding to the hard areas, on the impression, and scrape or trim those surfaces that represent the soft areas, on the model. If this plan is followed out carefully it results in the denture bearing harder on the soft, and lighter on the hard portions, and insures greater stability than can otherwise be obtained. In addition to relieving the impression and model, as described, it is frequently advisable to scrape the model entirely around its periphery, as outlined in Fig 3 *c*.

24. The distal termination of the denture should slightly

overlap and follow a line parallel with the distal margin of the palate bones to secure good adhesion. As before stated, the amount of overlap should be slight, not more than one or one and one-half millimeters. If excessive it will cause the patient more or less discomfort, and in addition to this very serious

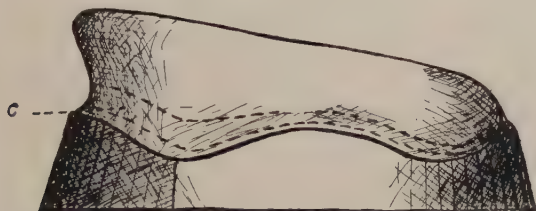


FIG. 3.

defect the palate muscles, when in action, will frequently dislodge the dentures.

25. In those cases where the tissue between the hard central area and the tuberosities is soft, the denture line on either side of the center may be terminated anterior to the distal margin of the palate bones without impairing the adhesive property of the denture.

26. A definite line should be scraped along this border, as shown in sectional view, Fig. 4*d*. When properly formed the denture margin will imbed itself in the tissues, thus securing accurate and close adaptation in this region. The buccal

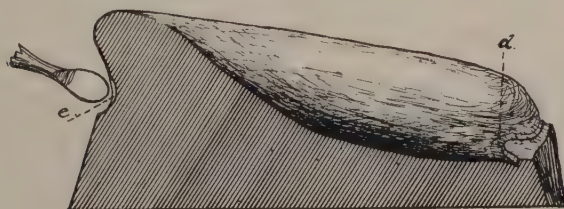


FIG. 4.

and labial adaptation is rendered more perfect by scraping these portions of the model, as indicated in Fig. 3. Fig. 4*e* shows how the scraping should be done on these surfaces.

In many mouths where the alveolar border is prominent and the arch is of average depth it will not be necessary to do much

scraping on the outer side of the ridge, the prominence of the border being sufficient to insure stability. In the examination of the mouth, the hard and soft portions along this line should also be noted and the model scraped accordingly, relieving to a very slight extent on the hard, and scraping more deeply on the soft, parts.

The Vacuum Chamber.

27. The value of the vacuum or "air" chamber, as it is ordinarily known, as a means of retaining dentures in position, has been called in question by many eminent prosthetists, while others as eminent maintain that its usefulness has been established beyond a doubt. My own opinion, based upon close observation for a number of years past, is that more satisfactory and uniform results can be attained by relieving impression and model as described.

The pattern forms for vacuum chambers furnished by the manufacturers are not of the proper shape to insure relief of the plate over the hard areas, and consequently will not prevent the tendency to rock under stress. The forms, as furnished, are, as a rule, shorter, and frequently broader than is necessary for the purpose of relief from pressure. Then, again, their presence requires that the plate be made thicker in the palatine portion than would be necessary if the method first outlined were followed.

CHAPTER III.

Impression Materials.

28. An artificial substitute designed to replace the lost natural teeth, when constructed of a plastic base, either vegetable or of *cast metal*, is molded against a plaster of Paris or an investment compound model. When the baseplate is of *swaged* metal, it is conformed to a metal die secured from a model.

The models used in the classes of work mentioned are derived from impressions of the mouth. If the impression is imperfect, the finished denture, regardless of the care and accuracy displayed in the intervening steps, will also be imperfect. Consequently accuracy in impression taking and model construction is of prime importance. A full, accurate and perfect impression of the mouth and parts involved, to which the substitute bears a close, or even a remote, relation, must be secured. Since accuracy is an absolute necessity, the choice of the medium used for this purpose is a subject requiring careful consideration.

Necessary Requirements of an Impression Material.

29. An impression material should possess certain requisite qualities or properties.

First—It should be composed of some material that is not disagreeable to the patient.

Second—It must be capable of being rendered plastic at a temperature the oral cavity can tolerate.

Third—It must be capable of copying accurately the fine lines and irregular surfaces to which it is applied without distorting them or becoming distorted itself, in removal from the mouth.

Fourth—It should harden in a reasonably short time—from one to three minutes—and should retain its shape when set.

Fifth—It should neither expand nor contract.

30. So far no material has been found which fulfills all of these requirements perfectly. The four most commonly used

materials in impression taking will now be briefly described, in the order of their value, viz.: Plaster of Paris, modeling compound, beeswax and gutta-percha.

Plaster of Paris.

31. Plaster of Paris is the most commonly used, and by many is considered the most reliable material for taking impressions of the mouth. Like all other mediums used for this purpose it has its disadvantages as well as advantages, but in most respects its superiority is unquestioned.

32. Its plasticity when freshly mixed, its tastelessness and freedom from odor, the facility with which the most irregular surfaces can be copied, its rapid setting properties, and the fact that it can be introduced in the mouth at ordinary temperatures, commend it for general use. Being inelastic and brittle, it breaks with a clean fracture, and the broken pieces can easily be placed together again in exact relation to each other, so that by its use the impression of any surface, however irregular, may be secured with accuracy.

33. Plaster of Paris is derived from the hydrated sulphate of calcium, the chemical formula of which is $\text{Ca S O}_4 2 \text{ H}_2 \text{ O}$. This mineral occurs in a number of forms. When transparent and crystalline it is called *selenite*, from the Greek word *selene*, meaning "the moon," and which alludes to its peculiar soft luster. This variety sometimes occurs in large plates, and formerly was used, instead of glass, for windows. These plates somewhat resemble mica, but are much softer, and although slightly flexible, are brittle and inelastic.

When it occurs in needle-shaped crystals or in fibrous form it is known as *fibrous gypsum*, or *satin spar*.

The ordinary massive, opaque crystals are called *gypsum*, and occur in varying colors—often red, yellow, brown or black—from the inclosed coloring matter.

It also occurs amorphous, oftentimes in compact translucent and snowy white masses, and is then termed *alabaster*. This variety is very beautiful, and, as it is easily carved, is used extensively for small ornaments and statuary.

Preparation.

34. The mineral *gypsum* is first crushed, then ground between burrstones to reduce it to a fine powder. The powdered mineral is then placed in large kettles or vats and calcined

by subjecting it to a temperature of 380° F. During this process considerable ebullition occurs, owing to the escape of the moisture. This process drives off the water of crystallization, thus dehydrating it. It must, however, be carefully conducted, for if under or over heated, the most essential quality of the plaster—namely, setting—will not be brought out or will be impaired, if not entirely destroyed.

Physical Properties.

35. Plaster of Paris possesses the property of “setting” or hardening again when mixed with water. It is a form of recrystallization, more or less imperfect, in which about the same equivalent of water is taken up as was expelled during the dehydrating process. As plaster of Paris possesses considerable affinity for moisture, care should be taken to keep it protected from the air and in a dry, warm place, since if left exposed it will, in time, abstract the moisture from the air and thus deteriorate and lose its setting property.

36. The time required for setting can be modified to suit the conditions, and is determined by the method of manipulation.

The addition of salt or sulphate of potassium to the water used in mixing will accelerate the setting, recrystallization occurring in from one-fourth to two minutes, according to the character and amount of the agent used and the length of time the mass is stirred.

37. Professor Henry Leffmann says of these agents: “It is well known that many saline substances, e. g., common salt, hasten the setting, but the exact cause is not definitely known. In the case of common salt, a double composition occurs to a slight extent, by which calcium chloride and sodium sulphate are formed. When a solution of the so-called *liquid sillex*, which is a sodium silicate, is put on a plaster cast, a similar reaction often occurs, forming sodium sulphate and calcium silicate, and the sodium sulphate appears on the surface of the cast in white, mosslike tufts.”

38. The addition of borax retards the setting of plaster very materially and the mass, when set, is of uncertain density.

Potassium alum has been highly recommended as a means of hastening the setting and of producing greater hardness to

plaster when set, but in a series of experiments recently conducted its value for either purpose mentioned was not proven.

Under the head of *physical properties* the movements which occur in plaster of Paris during and after setting should be mentioned.

Expansion of Plaster of Paris.

39. The tendency of plaster of Paris to expand during and after setting and the detrimental effects of this movement on denture adaptation has long been recognized by some, but, generally speaking, this subject has not received the attention it deserves.

There is no doubt in the minds of close observers that this detrimental movement is responsible for some of the many failures in denture adaptation.

40. When freshly mixed plaster begins to set it contracts slightly, then expands, and in assuming a thoroughly dry state, again contracts to a very slight degree. Some heat is noticeable during the setting process, due, no doubt, to the more or less imperfect chemical action as the calcium sulphate takes up water and begins to crystallize.

41. In an ordinary mix of plaster of Paris, one which sets in from one to three minutes, the contractile period usually lasts from one to four minutes, or until the evolution of heat becomes apparent. Then follows a short period of inertia, after which expansion begins. The expansive movement usually sets in slowly, increases rapidly for two or three minutes, then decreases gradually at first, and finally ceases altogether. Usually the greatest expansion is over in ten minutes, although the movement sometimes continues, in a gradually decreasing ratio, for twenty-four hours or more.

42. The rate and amount of expansion is very greatly influenced by the manner in which plaster of Paris is mixed with the water or the manner and length of time the mass is stirred. Long or rapid stirring greatly increases both the rate and the amount of expansion, while, conversely, stirring the mass slowly and to a very limited extent, very little movement will be noticeable.

For the purpose of accurately measuring the expansive movement of plaster of Paris and noting the effect of varying the methods of manipulation, the author has constructed a

micrometer for registering both expansion and contraction. This instrument is graduated to read to the .0001 of an inch or the .002 of a millimeter. The inch fraction is the unit of measurement used in the following recorded experiments. In reality, readings can be made to the $\frac{1}{40,000}$ of an inch. The spring actuating the contact rod is very delicate and offers but



FIG. 5.

little resistance to expansion, so that practically all of this movement can be noted. (See Fig. 5.)

43. The following records show the result of stirring the several mixes varying lengths of time. The mixes were practically identical as to weight of plaster, amount of water and temperature of room and materials. Nothing was added to accelerate setting or control expansion. Plaster was sifted

into the water. The only difference was in length of time each mix was stirred. The amount of expansion noticed in ten minutes and that recorded after twenty-four hours are given:

	Minutes stirred.	—Expansion—	
		10 minutes.	24 hours.
No. 1	$\frac{3}{4}$	2 pts.	61 $\frac{1}{2}$ l.
No. 2	1	32	101.5
No. 3	$1\frac{1}{4}$	61	93.5
No. 4	$1\frac{1}{2}$	93	118.5
No. 5	$1\frac{3}{4}$	118	134
No. 6	2	137	157.5

44. Many experiments have been made with different substances, singly, in combination, and in varying proportions, in an effort to determine some means of controlling this movement, but up to this time only partial success has been attained. The best results have been secured by adding sulphate of potassium in definite proportions to the water used in making the mix, and stirring the mass very little.

45. In prosthetic procedures the principal difficulty resulting from expansion is in the warpage of impression and models, when allowed to remain in the tray for any length of



FIG. A.

time after the plaster of Paris has set. Dr. W. Bowman McLeod of Edinburgh, Scotland, first called attention to the movement in plaster when confined. His experiment consisted in clamping metal bars to the edges of a large plate or slab and filling the enclosed space with properly mixed plaster of Paris. After twenty-four hours the bars were removed and the slab of plaster sawed diagonally through the center, when it was found that in the central portion it had arched up to a considerable extent, while the margins remained in contact with the plate. (See A.) This was due to the fact that lateral expansion was prevented by the bars, which, however, did not confine the material on its upper surface, and movement occurred in this direction.

46. An impression tray with its fixed sides (*a. b.* Fig 6) corresponds to the slab with clamped bars. The sides of the tray prevent lateral expansion, so that the movement is noticeable by the arching up or *warping* of the palatine portion of the impression, while the sides impressed by the alveolar border remain in close contact with the tray. The result is that the palatine portion of the impression has been increased in height, as shown

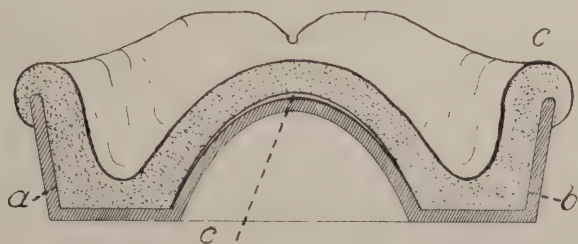


FIG. 6.

at *c*. Now, if the model be poured and allowed to remain in the impression for some time, a similar error produced by a similar cause, will result, thus establishing an additional increase in the height of the palatine arch.

Two errors, due to warpage, have thus occurred, which render the model an imperfect reproduction of the mouth it

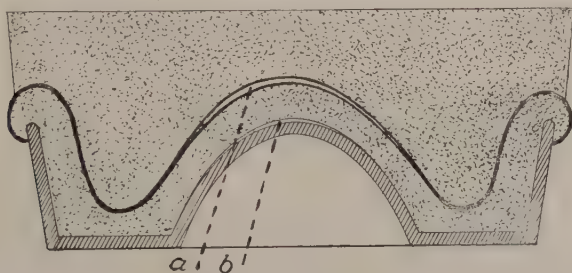


FIG. 7.

is supposed to represent. (See Fig. 7 *a. b.*) A denture molded over such a model will touch the palatine portion of the mouth before it is firmly seated on the alveolar border, and under stress of mastication will readily tip, and in many instances there will be no adhesion whatever.

47. The following suggestions are offered for *partially* overcoming warpage and compensating for expansion.

An ordinary mix of plaster of Paris, suitable for a good-sized impression, requires about 40 c.c. of water to 55 grams of plaster of Paris. Before sifting the plaster into the water .5 gram of potassium sulphate should be added to the latter and thoroughly dissolved. The plaster is then added slowly by sifting and the mass stirred very slightly by carrying the spatula around the bowl with a sweeping movement three or four times, or just sufficiently to insure a uniform mixture.

Plaster of Paris mixed in this manner will not usually expand more than ten or fifteen points, while if stirred in the ordinary manner and made without the addition of sulphate of potassium the expansion is apt to reach 100 or even 150 points in a very few minutes.

48. *Immediately* after removing an impression from the mouth it should be trimmed on those surfaces impressed by the hard areas, as before outlined, the separating medium applied, and the model secured. As soon as this has set sufficiently to permit, the tray should be removed from the impression, and the latter from the model. This plan, if carried out rapidly, will, to a great extent, obviate warpage, but will not control general expansion, since this movement continues for some hours. To *compensate* for expansion, the model should be scraped around the periphery, as outlined in the previous chapter.

Modeling Compound.

49. Modeling compound ranks next to plaster of Paris in importance and value as an impression material. It is made from many formulas, judging from the great difference in quality and appearance of the products of various manufacturers. The basis of all varieties consists of a gum possessing adhesive plastic properties. Gum copal, damar or kauri are used for this purpose. In addition to this base, French chalk and stearin are used in varying proportions, together with coloring and flavoring substances.

50. It is prepared for introduction into the mouth by heating in water that has been raised about to the boiling point. When entirely warmed through it is removed and the moisture absorbed by pressing it into or against a linen towel or napkin. It is then placed in the tray and introduced into the mouth.

51. Some of the varieties furnished recently are very contractile, and after being pressed against the tissues and removed, will become decidedly distorted, owing to the tendency to resume its original form, unless great care is taken to thoroughly chill it throughout while in position in the mouth. It will copy fine lines and irregular surfaces with a fair degree of accuracy, but is not equal to plaster of Paris in this respect, as there is more or less of a tendency to compress the tissues unless used very soft. When used in this condition it is apt to draw and distort by its own weight, and by the action of the palatal, tongue and cheek muscles in breathing. Where it is desired to compress the mouth in some parts and the ridge is firm enough to resist pressure, it can be used to good advantage, if not rendered too plastic. Some prosthetists use it almost exclusively for impression work, and become very expert in its manipulation, but the majority of dentists do not confine themselves to it alone; in fact, the large majority in most cases use plaster of Paris. Owing to the fact that it is inelastic and becomes distorted in removal from teeth with constricted cervices and from dovetailed spaces, it is not to be relied on in all cases. Better results can be attained with a material that breaks with a clean fracture, thus rendering it possible to replace the broken pieces in proper relation to each other, or one that is elastic and, if distorted, will spring back to original shape again.

Beeswax.

52. This well-known substance is collected from plants and stored by bees in the honey comb. It is prepared for use by extracting the honey from, and melting, the comb. Beeswax is usually of a light to medium yellow color, although at times it is very dark. It is bleached in the sun and by treating with acids more or less dilute. The bleached product is not quite as tenacious as it was before undergoing this process. This material was for many years about the only means at the disposal of the dentist for taking impressions, having long preceded the use of both gutta-percha and modeling compound for this purpose.

53. Its advantages are that it is pleasant in both taste and odor, is inelastic, contracts but little on cooling and is very

easy to manipulate. The principal disadvantage is that it distorts readily, and the same objections urged against modeling compound apply with equal force to beeswax.

Paraffine is sometimes added to beeswax to increase its plasticity and render it workable at a lower temperature than that at which the pure article alone can be handled. If added in excess the wax will separate in layers which are difficult to reunite again in a solid mass, and the combination is practically worthless.

54. It is usually made plastic by heating in water at a temperature of 120 to 130 degrees F. If heated beyond this point it begins to melt and becomes sticky. When properly softened it is removed from the water and dried by pressing into a linen towel or napkin when it is ready to place in the tray. Its principal use is for base plates and for carving the body of the denture previous to flasking, and for this purpose it is unexcelled. It is also used for securing the relation of the lower to the upper jaw, a step commonly known as "taking the bite."

It comes in various colors and combinations, as "Pink Paraffine and Wax," "Wax and Gutta-percha Base Plate," "Pink Wax," "Impression Wax," etc.

55. It is frequently employed as a preliminary impression material in partial and sometimes full cases, the impression thus obtained being trimmed and used as a matrix or improvised tray, into which plaster is poured and the final impression taken. By this means, the wax having been conformed to the tissues, a minimum quantity of plaster is carried to every surface involved, with less discomfort to the patient, while the ratio of expansion in the plaster is correspondingly less. In partial cases, however, the wax should be trimmed well away from around the remaining teeth, so that the plaster inclosing them may be of sufficient thickness, when fractured in removal, to be readily placed together again.

Gutta-Percha.

56. This material is the juice of a plant or tree belonging to the natural order, *Sapotaceae*, and is found in the Malay Peninsula, Borneo, and other islands of the Indian archipelago, on either side of the equator for a distance of two or three

degrees, or in a belt under the tropical sun from four to six degrees wide. The particular tree from which it is derived is the *Isonandra Gutta*. The word "gutta" in the Malay language means "gum," and "percha" is the name of the tree, so the term means the "gum of the percha tree." The juice was formerly collected by felling the tree, removing narrow strips of the bark and catching the sap in shallow bamboo vessels or on broad leaves as it dripped out of the incisions thus made. As this method, however, entirely destroyed the tree, the same plan is now followed as in the gathering of the sap from the *Siphonica Elastica*, or rubber tree, viz., slashing the tree, making a long, diagonal cut entirely through the bark and adjusting a trough under the incision, through which the escaping juice is carried into vessels to receive it. In this way the tree is not injured, if the girdling does not quite half encircle the tree. As more or less dirt and impurity is collected and mixed with the juice, the crude material is unfit for use. It is refined by first tearing into shreds in a special machine, washing and agitating in water and afterward boiling, to bring it into a coherent mass, in which form it is known as commercial gutta-percha.

57. Like rubber, it is a hydro-carbon, but, unlike that substance, it will deteriorate rapidly if exposed to the air, the oxygen of the air readily uniting with it, and the gum becomes brittle and loses its elasticity and strength. It can be mixed with sulphur and vulcanized, but the product, while more durable than the crude material, is not so permanent or lasting as vulcanite, and consequently is not used to any great extent in this form. The fresh commercial product is sometimes used for taking impressions of the mouth. It becomes quite plastic enough for this purpose at a temperature of 130 to 150 degrees F., and is prepared by softening in hot water. It will contract, however, unless dried and heated sufficiently to adhere to the sides of the tray. It is manipulated the same as modeling compound, except that ice water or a sponge saturated in it should be used to chill the impression before its removal. Being elastic, it will readily draw away from undercuts and bell-crowned teeth and immediately resume its proper form when pressure is relieved.

58. As it is difficult or almost impossible to secure the fresh

unadulterated product, its use as an impression material is very limited. The base plate gutta-percha furnished by the supply houses is not composed of the pure gum, but is a mixture of that with chalk, magnesia, oxide of zinc or some such products as these, together with some coloring matter. The addition of these substances prevents to a certain extent rapid deterioration, and also gives the required body for base plate work. In this form it is sometimes used as impression material, but is not satisfactory, since the heat required to render it plastic is too great to be tolerated by the oral tissues. The refined pure product, if fresh, can be used with excellent results in impression work if properly manipulated.

"Impression Compounds."

59. Other impression materials than those mentioned are furnished by the dental supply houses and are called impression compounds. The usual claim made is that they are composed of materials that can be dried after the impression is taken, and into which a metal die can be run direct without the necessity for usual model construction. The basis of most of these, however, is plaster, and in their action they very closely resemble it. Those recently tested showed more or less expansion, so that but little if anything is gained from their use, since the trimming of the model to assist in securing a uniform bearing of denture on tissues cannot be accomplished when die is made direct from impression.

CHAPTER IV.

Taking Impressions of the Mouth.

60. The term *impression*, in its dental application, usually refers to an imprint, a reverse copy, or a counterpart, of the upper or lower jaw, secured by impressing the parts involved with some suitable impression material, or, more briefly stated, an impression is a reverse copy or counterpart of the upper or lower jaw.

61. In taking impressions, an *impression tray* or *cup* is usually used for conveying the material to, and holding it in, position against the tissues of the mouth while hardening. It is also, in most cases, of material assistance in removing the impression from the mouth and in holding it together while securing the model.

Impression trays should conform, in a general way, to the form of the upper or lower arch. (See Figs. 15-16.) Those made from Britannia ware or German silver can be bent and conformed to meet the necessary requirements when irregular cases present.

62. Adjustable trays are often used when much adjustment is necessary. These are slotted at various points so as to permit the several parts of the tray to be easily bent or conformed as conditions may require. (See Figs. 8-9.) Trays can usually be bent with the fingers, although it is frequently necessary to use the pliers. Sometimes it will be found necessary to trim off an angle or a side, or shorten a tray, with the shears. When this is done the edges should be rounded smoothly with a file or scraper to prevent injury to the soft tissues.

63. The most common changes necessary to make with the shears are in cutting away the buccal flanges of lower trays, when adjusting to tissues much absorbed, in slitting lower trays in the median line on the lingual side so as to increase the bulk of impression material around the anterior teeth, when

any are present, and in cutting the median labial flanges of both upper and lower trays so as not to interfere with the frenum.

64. Impression trays are also made of vulcanite, porcelain,

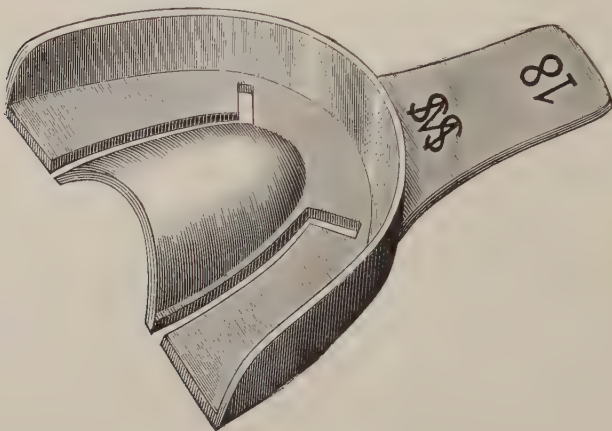


FIG. 8.

and of papier mache. These cannot be readily conformed to meet any irregularities, and for that reason are not as universal in their application as metal trays.

65. Sometimes, when a mouth is very irregular, and an

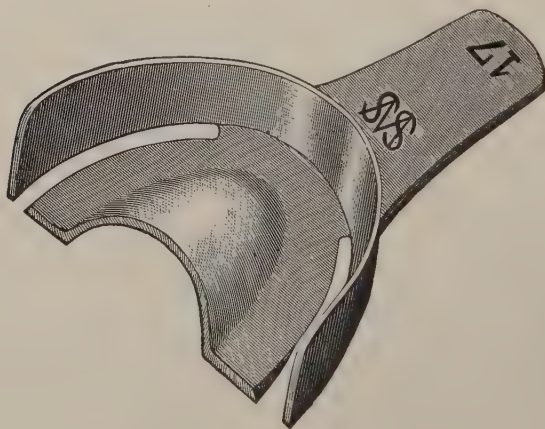


FIG. 9.

accurate impression cannot be secured with an ordinary tray, a wax or modeling compound impression is taken, and from this a plaster model secured. A die and counter die are then

run, and a tray to meet the special requirements is swaged and a handle attached by soldering. This may be made of 22-gauge brass or a Britannia tray meeting the general requirements may be placed on the die, swaged to fit, afterward trimmed where necessary, and finally smoothed and polished.

Taking Impressions of the Mouth. General Remarks.

66. When a patient presents for prosthetic procedures, the first step is to seat him in the chair, adjust it in suitable position, arrange a towel so as to protect the clothing, then wash the hands and make a thorough examination of the mouth. A chart of paper representing the upper and lower arches should be at hand and on it all points of interest should be noted. These may be enumerated as follows:

67. *First*—The number, position and condition of the natural teeth, if any remain.

Second—The condition of the alveolar border, and the extent to which absorption has progressed.

Third—The condition, location and extent of the hard and soft areas.

Fourth—The extraction of all useless roots or teeth that cannot be brought to a healthy condition by treatment should be indicated.

Fifth—The presence of calculus.

Sixth—All operative procedures should be noted.

Seventh—The general condition of the mouth and mucous membranes should be closely observed, and if treatments are necessary they should be indicated. To summarize:

68. *The extraction of roots or teeth, when necessary, the removal of calculus and deposits, the accomplishment of operative procedures and treatments should be completed before taking an impression for a denture.*

Taking it for granted that the mouth is in a healthy condition and suitable for the introduction of a denture, the next step will be the selection of a suitable impression tray.

Selecting Impression Trays.

69. In choosing a tray for a given case it should fulfill certain requirements.

First—It should conform, in a general way, to the parts from which the impression is to be secured.

Second—It should be from three to four mm. larger than the arch to insure ample space for impression material.

Third—In upper edentulous cases the tray should extend slightly beyond the tuberosities so as to support the impression material against these prominences as well as along the margin

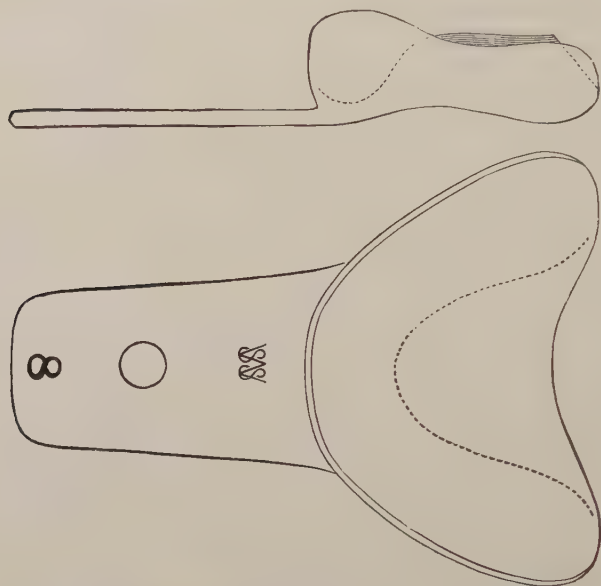


FIG. 10.

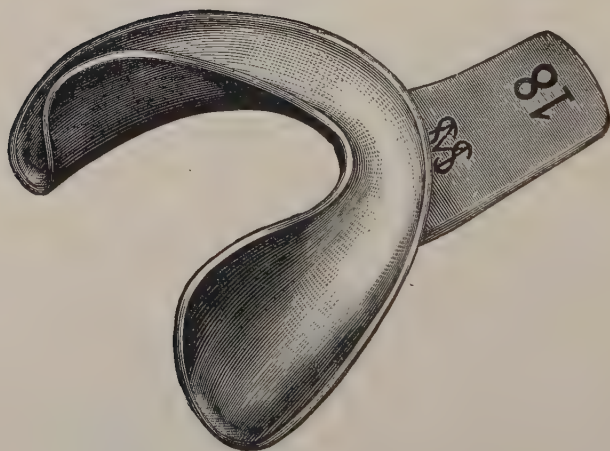


FIG. 11.

of the soft palate, against which the distal margin of the denture will terminate.

The hard area outlined in Chapter II, Fig. 3, frequently extends back, almost to the line of junction of the hard and soft palates. It is *absolutely necessary* that the impression be extended beyond this area to permit of proper trimming of the model, thereby securing, in the completed denture, maximum adhesive property.

70. If the tray selected fulfills the necessary requirements,

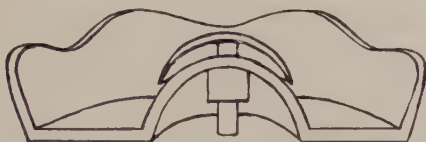


FIG 12.

with the exception of being short in the central palatine portion, this defect may be overcome, when plaster of Paris is used for the impression material, by building an extension of wax on this portion of the tray. Many points of seeming difficulty can readily be overcome by the exercise of a little ingenuity on the part of the operator.

71. Edentulous mouths do not, as a rule, require the use of deep-sided trays, the forms shown in Fig. 10 being most

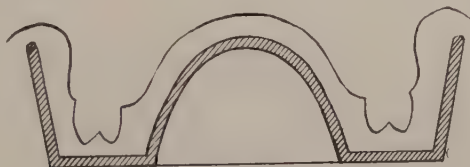


FIG. 13.

commonly used in these cases. These styles are furnished in sizes ranging from No. 1, the largest, to No. 8, the smallest. These trays have narrow rims and are cut low on the sides and in front so as to avoid pressure on the malar eminences, the reflected buccal muscles and the labial frenum.

72. When the palatine arch is exceptionally deep, a tray with a movable piece over this area is sometimes used, and when the material is introduced in the mouth and carried to

position, pressure is made on the movable portion by means of a projecting pin; in this way it is carried firmly up against the arch (see Fig. 12). When plaster is used in the ordinary tray the palatine portion can be built up with beeswax until it corresponds to the curve of the palatine vault.

73. In taking an impression of an arch where some of the

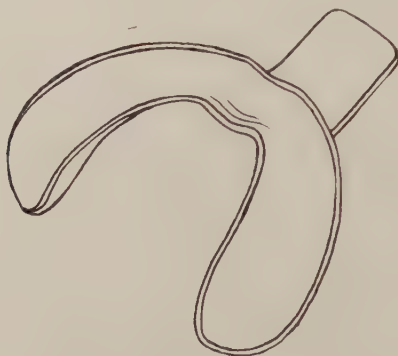


FIG. 14.

natural teeth are present, the use of a tray with more than ordinarily deep sides is indicated, in order that the impression material can be carried, not only against the buccal, labial and lingual sides of the teeth, but against these surfaces of the alveolar border as well (see Fig. 13). Shallow sided trays will not confine the impression material properly nor carry it

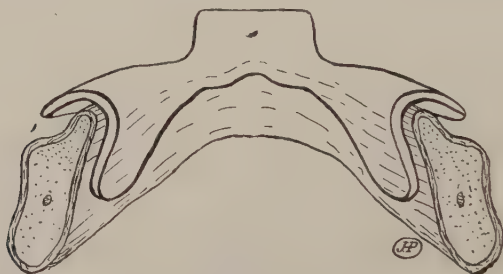


FIG. 15.

sufficiently far beyond the cervical portion of the teeth to furnish a good working model in these cases. Dr. E. H. Angle's set of trays is admirably adapted for taking impressions of partial cases, or where all the teeth remain, the sides being much deeper than the ordinary classes.

Fig. 14 shows the ordinary form of lower tray for edentulous jaws. The buccal wings are much shallower than the lingual, so that the tray may not be caught upon the outer side of the maxilla and thereby be prevented from going to its proper position. It is also raised in the central lingual portion, to prevent encroachment on the lingual fre-

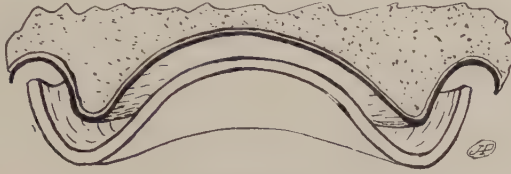


FIG. 16.

num, while the lingual posterior wings are quite prominent, so that the impression material may be carried as low as possible at these points, since, if the denture is extended well downward and backward in this region, it will be given greater stability than can be secured if constructed with narrow flanges. Fig. 11 shows another modification of this tray, with prominent lingual wings.

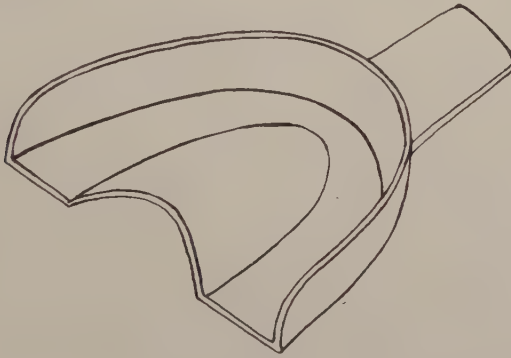


FIG. 17.

74. In fitting a lower tray it should be bent so that the crest of the alveolar border will occupy a central position in the body or depressed portion of the tray, as shown in Fig. 15.

Trays with flat bases and straight sides, as shown in Figs. 17 and 18, are often used for both upper and lower impressions. These are called partial impression trays. They do not

answer as well for partial cases as would a deeper-sided tray, for reasons before mentioned, but they are often useful in edentulous mouths.

Full Upper Impressions in Plaster of Paris.

75. Having selected the tray, the next step will be to mix and introduce the impression material. The ordinary rubber plaster bowl should be filled about one-fourth full of slightly warm water, to which is now added about .5 gram of potassium sulphate and the water stirred until the salt is dissolved.

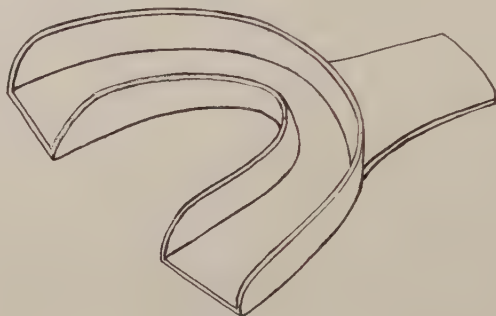


FIG. 18.

The plaster is taken up on the blade of the spatula and evenly sifted into the water until the mixture is of moderately thick consistency. It should be stirred very slightly to remove any air bubbles that may be present and to insure uniformity in the plastic mass. It is now placed in the tray, the palatine portion and that which is to be carried outside of the alveolar border being built a little higher than that in which the ridge is to be imbedded.

76. If the tray has been properly adjusted a large amount of plaster will be unnecessary, in fact, will be detrimental, because of the excessive surplus that will be forced backward while pressing the tray into position. When this occurs it occasions not only discomfort but danger to the patient. One case came to the notice of the writer not long since where a large amount of surplus was forced backward into the fauces, almost completely filling the pharyngeal space, and nearly asphyxiating the patient before its removal could be effected.

77. Sometimes it is a good plan to place a rim of wax

across the distal margin of the tray to prevent an excessive escape of surplus backward, thus avoiding this danger. When this is done the rim or roll of wax should be placed on the tray and attached by heating the point of the spatula and melting the wax against the tray at two or three points. The entire roll of wax should then be warmed and the tray fitted in the mouth, pressing it well into position so that the wax may be conformed to the shape of the arch. The tray having been filled, the material is introduced into the mouth by inserting the right angle of the tray into the right angle of the mouth. The left angle of the mouth is distended by inserting the index finger of the left hand into that angle and exerting tension almost directly outward at right angles to the alveolar process. This permits the left side of the tray to be rotated into position without difficulty. After tray with contents is in the mouth it can be carried up to position, using even, gradual pressure. Care should be taken to see that the tray is properly centered and evenly balanced, so that the material will be of uniform thickness in all parts.

78. It is a good plan, before the tray is quite in place, to pass the index fingers back between the sides of the tray and the buccinator muscles and exert pressure outward, so as to draw out any folds of these muscles that may have been caught by the margin of tray. The same plan should be followed in the anterior part of the mouth and the lips pulled outward for the same reason. The tray should, of course, be held in position firmly with the opposite hand, and this step performed as rapidly as possible, before the plaster has had time to set. The fingers are then placed back in the molar and bicuspid region, one on either side, and firm, steady pressure brought upon the tray, carrying it up into position as far as possible without causing the patient unnecessary discomfort. When once properly placed it should be held firmly in position, with the index and middle finger resting on the central palatine portion. Pressure should now be brought upon the lips and cheeks with the fingers, so as to force the surplus plaster lying above the margin of the tray into close contact with the buccal and labial surfaces of the border, as far up as the attachment of the muscles will per-

mit. The tray is now held gently but firmly in position until the plaster has fully set.

79. The most common method for testing the setting is to break the surplus portion remaining in the bowl, and when the fracture is clean and sharp the impression is ready for removal. The impression itself can be tested with the fingernail or a knife blade, and when able to resist pressure fairly well, when thus applied, it is ready to remove.

80. In edentulous cases removal is not, as a rule, difficult to accomplish. The operator should exert gentle traction on the handle of the tray, moving it upward and downward until the impression has become dislodged. It is then rotated out of the mouth in very much the same manner as it was inserted. Sometimes, however, it is a difficult matter to dislodge the impression, adhesion and the almost perfect exclusion of the air being able to resist a considerable amount of force exercised by the operator.

81. When this occurs the adhesion can usually be broken by instructing the patient to cough quite forcibly. This forces the air between the palatal arch and the plaster and is generally successful. In addition to the efforts of the patient, traction on the tray handle should be exerted upward, so as to depress the posterior margin of impression. After removing tray and contents the impression should be examined quickly to see that no essential portion of it still remains in the mouth. When satisfied that all needed parts are intact or preserved, the patient should be given a glass of water, and instructed to clear and rinse the mouth of the remaining portions of plaster and debris.

Full Lower Impressions in Plaster of Paris.

82. In full cases the tray, as a rule, should be of the shallow forms shown in Figs. 10 and 14, although this is regulated entirely by the amount of alveolar absorption that has occurred. The mixing of the impression material is accomplished in the same manner as previously described. It should, however, be stiff enough to keep its position when the tray is inverted, as it must necessarily be when carried into the mouth. The operator should stand somewhat in front, and to the right, of the patient, and introduce the left angle of the tray into the

left angle of the mouth, distend the right side with the left index finger and rotate the right angle of tray in position. It should now be evenly centered over the border, and slight pressure made upon it to carry it partly down to position.

83. The fingers should now be passed backward between the sides of the tray and the cheek to pull out any folds of the buccal mucous membrane or muscles that may have caught on sides of tray. This occurs much more frequently in lower than in upper cases, and this precaution should under no circumstances be neglected. The patient should now be instructed to push the tongue upward and forward as far as possible, so as to allow the tray and material to be carried down into position on the lingual surface of border without interference. This also marks the location and extent of attachment, of lingual frenum, so that when the denture is constructed it may be made shallow enough at this point to prevent displacement by the glossal muscles. The tray should now be pressed down to position, using the fingers on the top of the tray and the thumbs under the sides of the jaw, or the operator can step back of the patient, placing left hand around left side of head and exert pressure on the tray with thumbs on each side and fingers under the jaw.

84. The chair, of course, should be low and the patient instructed to sit upright until the impression is in position, and then throw the head still further forward, so that, should any plaster become dislodged from the impression it will not fall backward into the fauces. The tray should be held firmly but gently in position by the operator, not by the handle, but with the finger or thumbs resting on the lateral halves, keeping pressure upon it until the plaster has firmly set. In lower cases, where the saliva is profuse, it is a good plan just before introducing the filled tray to dry the mouth with a linen napkin. In this manner the impression material can be carried to place before the saliva refills the mouth. Its presence tends to retard the setting of the plaster and it also impairs its quality to a certain extent, rendering it softer, and consequently more easily broken.

85. Difficulty in the removal of full lower impressions is very rare indeed, unless the border is irregular and presents

undercuts in the sides, or the plaster may be forced down under the internal oblique line, in which event the steps would be the same as those to be hereafter described for the removal of impressions in difficult cases. Usually pulling out the lips and cheeks will afford ingress for the air, and gentle traction, up and down on the handle of the tray, will readily displace the impression, so that it may be rotated out of the mouth without difficulty.

Difficult Cases.

86. Under this head may be mentioned:

First: Cases in which the alveolar border is prominent and irregular, presenting depressions and undercuts from which the impression cannot be removed without injuring the tissues themselves, unless it is broken and removed in pieces.

Second: Cases in which the alveolar process has been almost completely absorbed, so that it is difficult to secure an impression, especially in lower cases, of the surfaces on which the denture is to rest without interference from the tongue and cheek muscles.

Third: Cases in which the mouth is small and the orbicularis oris muscle seems incapable of much distension.

Fourth: Cases in which the patient cannot tolerate the introduction or presence of the impression material.

87. In the first class of cases, when, upon examination, it is found that the presence of the depressions will not permit of the ready removal of the impression material, the tray should be oiled before introducing the plaster, and after the impression has set it will readily come away, leaving the impression in the mouth; this is now cut so as to remove the undercut portions in sections, when the remainder, being thus freed, can easily be removed.

88. In the second class mentioned, a tray with very shallow sides should be fitted to the mouth, since but little ridge remains. Frequently it will be best to take a preliminary impression in wax or modeling compound, cut away the excessive surplus and use the trimmed impression for a tray for holding plaster. This is a most excellent method where the cheek and tongue muscles are inclined to fold over the alveolar border, as the wax or compound presses them out

of the way, not only in the preliminary but in the second impression as well.

89. The third class mentioned is certainly a difficult one at times from which to secure a good impression. The tray should be fitted so as to conform as accurately as possible to the border. The lips, inside and out, and the outside of the tray, should be slightly rubbed with vaseline. The sides of the tray should be of approximately the same depth as the border, so as not to interfere with nor be disturbed by the reflection of the buccal or lingual muscles. The angle of the tray should be inserted into the mouth and carried well back before attempting to rotate the other side into position. The opposite angle of the mouth should be distended as far as possible with the index finger and pressure brought upon the tray to press the opposite side of the mouth away from the angle in which the finger is inserted. Sometimes the presence of the finger in the angle of the mouth interferes with the passage of the tray into the oral cavity. When this occurs the use of a cheek or lip distender will often obviate this trouble. No difficulty will be met with in removing the impression, except, perhaps, the inconvenience to the patient. The tray should be rotated out of the mouth, bringing one side entirely out before carrying the opposite side outward to any extent.

90. In the fourth class of cases occasional difficulty is met with on account of the extreme irritability of the fauces and the area of tissue about the line of junction of the hard with soft palate. A number of methods for overcoming this is recommended. One is to paint or swab the tissues in the pharyngeal space with camphor water before introducing the impression material; another is to use a strong solution of tannin, and still another is the use of a solution of potassium bromide. I have met with a few cases in which none of these agents just mentioned controlled the difficulty, but it was entirely overcome by brushing the parts with a 2 to 4 per cent solution of cocaine. A wisp of cotton wrapped on the end of a small piece of wood or a pencil, to be used by patients occasionally, for a few hours before sitting for an impression, will frequently, by accustoming the parts to the presence of a foreign substance, enable them to undergo the ordeal without discomfort.

The judgment of the operator will determine in most instances the best method to pursue in the introduction and removal of impressions in difficult cases, it being impossible to lay down a fixed set of rules to be governed by, since no two cases are exactly alike.

Partial Cases in Plaster of Paris.

91. In taking impressions of partial cases in plaster, the tray should first be fitted and then oiled so that it will readily part from the plaster after it has set. The manner of fitting the tray, mixing and introducing the material, manipulation of the cheeks and lips, and the final pressing of the tray into position, is similar in every detail to that just given for full edentulous cases. In selecting a tray, however, for partial cases, one with deep sides should invariably be chosen, for the reasons already assigned.

92. When an upper impression has set sufficiently to remove, the tray should be loosened by placing the points of the index or middle fingers against the trap, over the tuberosities, and pressing upward at these points, while downward pressure is exerted upon the handle with the thumbs. In lower cases the operator should stand back of the patient and place the thumbs upon the distal ends of the tray and exert pressure upward on the handle with the index fingers, or stand on the right side, and somewhat in front, and place the index fingers on the distal ends of the tray and press upward on the handle with the thumbs. This method is usually quite effective and the tray will come away readily. It should now be wiped free from all debris and placed ready to receive the pieces of the impression as they are taken out.

93. When the anterior teeth remain in the mouth, an incision or groove should be cut over each cuspid tooth and eminence, extending from the extreme upper to lower margin of the impression, and practically through it. The anterior section is now broken out and laid aside. When any of the bicuspid or molars are missing, and there remains a tooth back of the space, the impression should be cut through on the occlusal face, and deeply enough to allow the buccal portion to be readily broken away. If no teeth are missing along the buccal region, usually pressure exerted against the broken

end of the remaining buccal side will displace it without any cutting on the occlusal surface being necessary. The lingual portions of the impression can readily be removed by exerting pressure lingually on the broken surface. The object in cutting the impression and removing it in pieces is to prevent undue strain on the isolated teeth, and also to preserve perfectly all the irregularities of dovetailed and interproximate spaces and undercut surfaces that may be present.

The use of plaster in partial cases will insure absolutely accurate results in impressions if the details are carefully carried out.

94. In placing together broken impressions, it is necessary, first, to see that the tray is clean and free from all particles and debris that would prevent the broken pieces resting flatly on the surfaces from which they were removed. The fractured surfaces, as well as those which rested on the tray, should also be brushed to remove all foreign particles adhering to them. The pieces are now placed back in the tray, carefully fitting them, one against the other, until they are all in proper place. Wax is melted against the outer sides of pieces and tray in order to hold them in place during the filling of the impression.

Modeling Compound Impression.

95. In taking impressions with this material the same care in selection of trays and all such details as are common to impression work in general must be observed. As stated in the previous lecture, modeling compound is prepared for impression work by heating in water. It is a good plan to place a piece of paper in the bottom of the pan in which the water is heated to prevent the compound from sticking to the metal while being prepared. The heat should be slow and gradual rather than rapid, so that the material may be entirely softened throughout. It is not necessary to bring the water to boiling point to render the compound plastic if the heat is continued for some length of time. When thoroughly softened it is dried in a towel and placed in the selected tray, adjusting it in much the same manner as the plaster was placed, i. e., higher in palatine portion and around the rim of tray than where the border will enter. Sometimes, after adjusting the tray, the surface is slightly warmed over a flame just before introducing

into the mouth, but this is unnecessary if it is of the proper plasticity.

96. The methods of introduction into the mouth, manipulation of the lips and cheeks, pressing and holding tray in position, etc., are similar to those described in plaster work. In order to prevent distortion, the compound should be cooled by throwing a fine stream of ice water upon it or with blasts of cold air from the chip blower, before removal from the mouth. Cold air is preferable, being much less disagreeable to the patient, and if properly applied is quite as efficient as the water. The removal of the impression is effected in the same way as before described, except that after loosening, it should be quickly rotated out of the mouth, for if not quite cold the pressure of the orbicularis muscle is liable to cause distortion of margins. It should be immediately placed in cold water after removal to harden it. If introduced into the mouth in a very plastic condition and much surplus is present, it is apt to drag away from the highest part of the arch by force of gravity, there being nothing to support it over the distal margin of the tray. Care should therefore be taken to have as little surplus present as possible.

97. The movement of the palatal muscles in breathing is also apt to distort the palatine portion of the impression more or less, unless the patient is instructed to breathe through the nose. It is a good plan in all impression work to so instruct the patient, as there will be less liability to sensitiveness than where the palate is alternately lifted and allowed again to come in contact with the impression material. Modeling compound will not spring back to its position if distorted to any extent in removal from the mouth; therefore, its use is contra-indicated in partial cases where there are dovetailed spaces, or teeth with constricted necks present. My own experience with this material has been that the compounds that are the most elastic—and some are quite so—are also the most contractile, so that but little dependence is to be placed on their accuracy when possessing this property in a marked degree. A roll of the compound, about one-half inch in diameter and four inches long, was drawn out to eight inches in length, when it contracted one and one-half inches almost immediately. It also showed a tendency to draw away from the sides of the tray

after removal from the mouth. This is not true of all or many of the compounds sold, but the particular piece I mentioned was presented as a sample of one possessing good elastic property.

The best grades of modeling compound can be used for edentulous mouths where the ridge is firm and resistant to pressure, but where the border is soft and flabby and easily distorted its use is contra-indicated.

Beeswax Impressions.

98. This material, in its preparation, is manipulated very much the same as modeling compound. Owing to the fact that considerable pressure is required to conform it to any object, its use is contra-indicated in those mouths where the border is soft and yielding, as distortion of the tissues themselves would most certainly occur when pressure is exerted. The manner of placing it in the tray, introducing into the mouth, manipulation of the lips and cheeks, and final pressing into position, is similar to that already described. In removal from the mouth care must be taken that in breaking the adhesion the impression itself is not bent out of shape. The orbicularis muscles will also tend to distort the sides unless the impression, after being loosened, is quickly rotated out of the mouth. It should be chilled in water as soon as removed.

Gutta-Percha Impressions.

99. The general details of working this material correspond so closely to those of the two just given that we will omit a minute description of methods, since it would only be a more or less tiresome repetition. It is well, however, to remember the physical properties previously described and stick the gutta-percha to the sides of the tray by heating in a Bunsen flame before introducing into the mouth. This is done in order to prevent or overcome the tendency to contract on cooling.

If ordinary base plate gutta-percha is used it is placed in a vessel of water and heat applied. The sheets are stirred with a stick and worked up into a coherent mass, then taken from the water and dried, placed in a tray and subjected to the dry heat of the burner for an instant, and then introduced into the mouth.

The crude material, however, if fresh, will give much better results than the base plate, but, as before stated, it is difficult to procure it in good condition, owing to the fact that it oxidizes so rapidly.

It can be positively stated that none of the plastic impression materials will give as good results, in general impression work, as plaster of Paris, and that the more difficult the case the more positively is the use of the latter indicated.

CHAPTER V.

Construction of Models.

100. Following the logical order of procedure in denture construction, the next step after securing an impression is to prepare it and secure the model.

Models over which the plastic dentures are to be molded or which are to be used in securing dies for swaged metal work, should be smooth and free from blemishes, and should represent, as nearly as possible, the mouths from which the impressions were taken. As stated in a previous lecture, and I will again emphasize it here, if success is attained in the adaptation and fitting of a finished denture to the mouth, it is imperative that the impression and the model be practically perfect. The finished impression or model represents the sum total of the detail work as it is carried forward, step by step. Just in proportion as these steps are carefully or carelessly carried out will this part of the work be perfect or imperfect. The method of treatment of the impression as to varnishing, and filling in the plaster which is to constitute the model, is largely responsible for the accuracy of the model. Having secured the impression, it should be trimmed as indicated in Chap. II., Par. 22, so as to insure as uniform bearing as possible of the denture on the surfaces upon which it is to rest. This step must not, under any circumstances, be omitted, for the reasons heretofore given. The proper time for doing this is immediately upon the removal of the impression from the mouth.

101. If an upper and lower impression is to be taken, secure one, prepare and pour it, and while the model is hardening secure the other one. If, when this is accomplished, the plaster model in the first is sufficiently hard to permit, remove the tray and let the case rest until the second impression is prepared and filled, and while the plaster in that is setting remove the first impression from model. By so alternating, but little more

time will be required than if both impressions are first taken before either is filled, and the danger of warpage is very much reduced. In preparing an impression for filling, any surplus margins or useless impression material adhering to the sides of the tray should be brushed away and impression freed from all debris. If of plaster, its surface should be covered with some separating medium to prevent the adhesion of the plaster model to the impression. If the impression is of modeling compound its surface should be saturated with water and the surplus thrown out before filling. When of beeswax, water also can be used, but better results will be attained if the surface is carefully brushed over with a *thin film* of oil.

We will first take up the method of treatment of plaster impressions, preparatory to pouring the plaster model.

Separating Mediums, Varnishes, Etc.

102. Shellac varnish is usually used to coat the surface of plaster impressions. It is not a separating medium and should not be used as such. The object in using it is to discolor the surface of the impression to a slight depth, so that in cutting it away from the model the latter will not be marred with the knife, the discolored portion readily indicating the line of demarkation between the two. It also fills in the minute pores of the impression surface and prevents the ready penetration, into this surface, of the true separating medium. If a thin alcoholic solution is used, it readily penetrates the plaster without forming a film. There are several varnishes, substances or mixtures used for preventing the plaster, which constitutes the model, from adhering to the impression, among which may be mentioned sandarac varnish, collodion, soap solutions, oil and saturation with water.

Sandarac Varnish.

103. This varnish is a true separating medium, and, if properly handled, most excellent results can be attained from its use. It is made by dissolving gum sandarac, in the proportion of one ounce of the gum to six ounces of alcohol. In applying it for a separating medium, one thin, uniform coating should be brushed evenly over the impression surface with a flexible sable or camel's hair brush, and the varnish allowed to dry for a short time before filling the impression.

Collodion.

104. This substance is made by dissolving gun cotton in ether. Most dentists prefer to use the prepared commercial product rather than attempt to manufacture it, as gun cotton is highly explosive and dangerous to keep in the laboratory. When collodion becomes thickened and unsuitable for use, due to the evaporation of the ether, the addition of a little of the latter will thin and restore it to proper consistency. It is *one of the best*, if not the *very best*, separating media available. The method of application is practically the same as when sandarac varnish is used. After the film has been applied and allowed to dry for a moment or two, the impression should be soaked in water for an equal length of time, and the surplus shaken out before filling in the plaster.

Soap Solutions.

105. Solutions of soap, both aqueous and ethereal, are used for separating purposes. When either variety is employed it can be liberally applied and allowed to remain on the impression for three or four minutes, when the surplus may be washed away by holding the impression under the hydrant and allowing the water to fall upon it, or by immersing in water and removing the excess with a brush. If applied in a lathery condition and these precautions are not taken the model will come out defective, owing to the retention of air in the lather in the deeper portions of the impression.

Separating Medium, Etc.

106. Under the names of "Separating Medium," "Parting Varnish," etc., are included the varnishes furnished by the supply houses. These usually consist of a combined staining and separating medium, and when employed, the use of shellac varnish as a staining fluid can be omitted. Very good results as a rule are secured from these various preparations if care is observed in applying them.

Oil.

107. Oil is used by some for preventing the union of the model with impression. It should be applied sparingly, however, for if used too plentifully it will settle in the deeper

parts of the impression, and, the specific gravity of the plaster not being sufficient to displace it, the model will be more or less indefinite. Any of the other means of separation mentioned will, as a general rule, give more accurate results than oil. It is, however, most commonly used for flask separation and answers very well for that purpose.

Saturation with Water.

108. Soaking the impression in water four or five minutes, removing the surplus water and filling, is a plan followed by some with good results. In partial cases it is best to use the shellac varnish for staining purposes, but in full cases this can be omitted. All impressions should, of course, be removed from the model as soon as sufficiently hardened, but when the plan of separation just mentioned is followed it becomes doubly necessary, since, if allowed to stand for any great length of time, it will be impossible to part the two without injuring the model.

109. Any separating fluid or varnish, except the last one mentioned, should be used sparingly, or the fine lines and delicate surface markings of the impression will be more or less obliterated, and cause the model to be correspondingly imperfect. The thinner the film of medium, of whatever character used, that will accomplish separation, the more perfect the model will be.

Filling the Impression.

110. The impression having been trimmed as outlined and the separating medium applied, the next step will be to mix the plaster. This is done in much the same manner as described in impression work. The bowl is filled about one-third or one-half full of water, sulphate of potassium being added this time in the same proportion as when used for impression work. The plaster is taken up on the blade of the spatula and gradually sifted into the water until the mass is of the proper consistency. It should then be stirred slightly to insure uniformity throughout and also to expel any air bubbles that may be present. The mass should be as stiff as possible to be consistent with its proper introduction into the impression, in order to insure density and hardness in the plaster model. It

is not a correct plan to set the impression on the bench and pour the plaster from the bowl into it.

111. Plaster used so thin that it may be *poured* will produce a very unsatisfactory model and although it may appear to be all right its density is more or less variable and uncertain. Such a model under the pressure to which it is subjected in closing the packed flask will yield and become more or less distorted, while the denture molded against it will become correspondingly so. The tray containing the impression is now taken in one hand and brought to the edge of the bench. A little plaster is taken up on the end of the spatula and placed on the palatine part of the impression, if an upper, or a little to one side of the median line, if a lower, and the tray shaken over the edge of the bench to jolt or settle the plaster down into the deepest part of the impression. When this has been accomplished more is added and the shaking repeated until the entire impression surface is covered.

112. In filling impressions of partial cases it is very necessary that only a small amount of plaster be first placed on the impression surface and that this be shaken until it runs down the lingual impressions of the teeth and reaches the bottom or deepest parts before it comes in contact with the

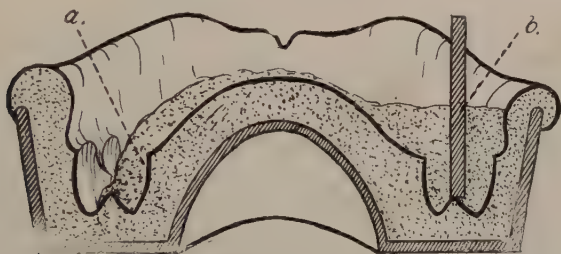


FIG. 19.

labial or buccal portions. See Fig. 19 *a.* This can readily be seen, if the plaster is properly mixed and introduced, and care should be taken in filling these impressions to see that the teeth matrices or impressions are properly and perfectly filled, otherwise the air will become confined in the deepest portion of the impression, the plaster will be unable to displace it and the model will come out with imperfect plaster teeth.

113. In partial cases, when the teeth are long and slim and

isolated, they are apt to break, when separating the impression from the model, or in the subsequent steps of waxing, flasking, etc. When filling the impression, if a small peg of orange wood or a small toothpick of some tough wood, say 2 mm. in diameter, and of sufficient length to extend well into the body of the model, be inserted into the plaster, which fills each tooth impression, and placed so as to occupy a central position in the plaster tooth parallel with its long axis, it will strengthen the tooth so as to withstand any ordinary stress without breaking. Fig. 19b represents an impression partially filled with peg in position.

114. Metal pins or wire have been recommended for this purpose, but in the flasking of most partial cases it becomes necessary to cut away the plaster teeth to a greater or less extent, and if the pins are of metal they interfere in trimming the plaster down, which will often cause fracture of the plaster tooth. When wood is used, the pegs are cut almost as easily as the plaster itself, thus obviating this danger. The surface of the impression having been covered with plaster, and this jarred down until it is compact and dense, more is now added to give the body of the model its proper shape.

Form of Upper Models.

115. Upper models should be constructed with flat bases and slightly tapering sides, similar to Fig. 20, lower model. They should not be more than 12 to 16 mm. thick through the palatine portion. If thicker than this it will usually be

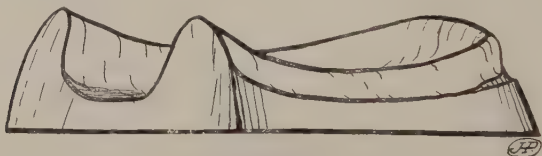


FIG. 20.

necessary to cut some of the base away preparatory to flasking. Having covered the impression surface and added a sufficient amount of plaster to form the body, the impression with contents can be inverted and pressed evenly down upon a glass slab or piece of paper, and the sides smoothed up with the spatula, or the model may be given its proper form while

the plaster is still plastic by smoothing and squaring up the sides and base with the spatula.

Form of Lower Models.

116. Lower models should be constructed with a solid base connecting the lateral halves with each other. The crescent form frequently given them is not calculated to withstand stress, and such models are often broken in trimming or in removing from the occluding frame. Fig. 20 shows the proper form for these models. After the actual impression surface has been covered and the plaster shaken down into position, the space between the lateral halves is bridged over with the somewhat stiffened plaster, or a ball of damp paper can be rolled and pressed into this space to act as a floor or support for the plaster to be added. A sheet of wax can also be fitted and attached by melting to the margins of the impression previous to filling. This base should be from 6 to 10 mm. thick, and may be flattened by inverting the case on the glass slab, as described for upper models, or it may be properly shaped with the spatula.

Removing the Impressions, Full Cases.

117. As soon as the plaster has set properly, and this usually requires from ten to fifteen minutes, the tray should be lightly tapped and removed from the impression. In full cases, if there are no undercut surfaces, a little tapping of the impression will loosen it, so that by inserting the point of the knife against the buccal surface at the line of junction of impression with model, this portion will readily come away. The labial and opposite buccal portions are removed in the same manner and then the knife is pressed into the distal portion and this piece lifted out. Care should be exercised during this step that the point of the knife does not mar the surface of the model in any way. When the impression is all removed the model should be trimmed around its periphery to approximately the outline the denture will be given, leaving it, however, from 2 to 4 mm. larger than the outline of the latter.

Removing Impressions from Models in Partial Cases.

118. In separating partial cases much more care is necessary than in those where no teeth are present. The usual plan pursued is to remove the tray as above described, then with a sharp knife trim the impression away, over the occlusal or incisal ends of the remaining teeth and the corresponding prominences of the alveolar border, until the stained surface of the plaster appears. It is also advisable to make a number of V-shaped cuts around the buccal and labial portions of the impression from upper to lower margin, parallel with the long axes of the teeth and deep enough to uncover the discolored surface. These sections can now be tapped very lightly, the point of the knife passed into the line of junction and the pieces broken away, one at a time. The entire labial

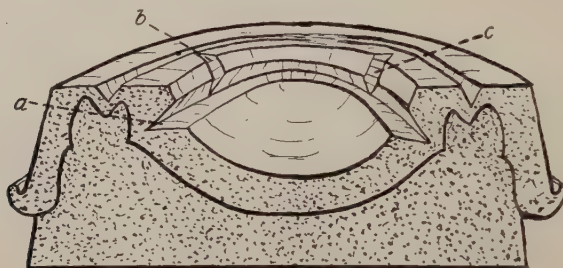


FIG. 21.

and buccal portions of the impression should be removed before any attempt is made to remove the lingual portion. If an effort is made to pry out this part of the impression before the outer sides are removed, the plaster teeth would most certainly be broken away. A V-shaped groove is cut on the lingual sides of the teeth, 3 or 4 mm. away from them, and directed toward their cervical portion, Fig. 21a. This is carried down until the stained surface of plaster can be seen. V-shaped cuts are now made opposite and carried almost to each tooth, *b*, *c*. These sections are now broken away, one at a time, care being taken not to use the tooth as a fulcrum. It is absolutely necessary that each tooth be entirely free from any impression material before lifting out the palatine part of the impression. If the teeth are isolated, the portions of plaster filling the spaces between must be carefully cut away.

119. Several precautions must be observed in separating partial impression from models; first, the teeth should not be used as fulcrums; second, in prying sections loose, the pressure should always be from and not against the teeth; third, the knife must be under absolute control and perfectly guarded to prevent marring the model. A good plan is to grasp the model with one hand, placing the thumb at the point where the fulcrum is desired, and using it as such. This is a method that can be followed successfully, not only in the class of work under consideration, but also in carving and festooning the gums in finishing dentures.

The sections of plaster between the V-shaped grooves, on the lingual surfaces of the teeth, having all been carefully pried out, and the teeth entirely freed from contact with the remaining portion, the palatine or lingual part should now be tapped lightly to loosen it, and the point of the knife inserted at the distal extremity to lift it out.

Separation of Modeling Compound, Wax and Gutta-Percha Impressions from Models.

120. Separation of modeling compound, wax and gutta-percha impressions from models is not so difficult nor tedious, especially in partial cases, as in plaster impressions. After the plaster has set the case can be placed in a vessel of warm water and heat gradually applied to soften the impression. The temperature should be slow and moderate, rather than rapid, to give the impression material time to become heated entirely through.

121. If heated rapidly the outer or more exposed portions become sticky and unmanageable, while the deeper parts are scarcely warmed, and if an attempt is made to separate at this time, in partial cases, the teeth will usually be fractured. If overheated throughout, the impression material will adhere to the model, and, in the case of wax, render it greasy and dirty after removal.

122. When small portions of modeling compound adhere to the model they can be removed by heating a piece of compound in the Bunsen flame and pressing firmly against the adherent portions for a few seconds and then pulling it away. This usually removes the small pieces without the necessity

of scraping them off, a step which is apt to impair the model more or less. Dry heat, moderately applied until the impression material is softened throughout, is also used by many, in separating. The model is, perhaps, left in a better condition when this plan is followed, since it is not filled with water, as is the case when separation is accomplished by the former method. There is greater danger of breaking the teeth, however, since more time is required to soften the impression material, and one is apt to hurry matters, with disastrous results.

123. As before stated, the surplus portions of plaster around the periphery of the model, or on the base, if that has been built up unevenly, should be trimmed away as soon as possible after separation has been accomplished. This is done at this time for two reasons; first, because the plaster can be cut and shaped so much more readily when freshly set than if allowed to dry, and, second, the surplus, if allowed to remain, only serves to interfere with the proper handling of the model in the subsequent steps of denture construction. The model should extend somewhat beyond the line which will mark the peripheral outline of the denture, from 2 to 4 mms. It is a good plan to study the model carefully, locate the denture outline with a pencil, and then trim accordingly. Models for partial cases are trimmed along practically the same lines, except where the teeth are present; these, as well as the buccal and labial surfaces of the border, are kept intact until case is ready for flasking, when they can be cut away as the conditions demand.

Models for Celluloid Cases.

124. Models prepared for celluloid work should be thicker than for vulcanite cases, in order to withstand the great amount of stress to which they will be subjected in the closing of the flask. In general form they are the same as already outlined, but should be from 15 to 20 mm. thick in the thinnest part of the palatine portion. It is also thought by some that if these models are constructed of a coarse grade of plaster—that known as builders' plaster—there will be less liability of warpage due to stress of closing, occurring, than when the finer grades of plaster are used. My observation leads me to believe that what is gained in this respect is lost in the greater expansion that occurs in the original setting of the model.

Models for Cast Metal Bases.

125. When cast metal bases are to be constructed the models should be made of some material that will withstand the heat necessary for thoroughly drying out the case, without shrinking or checking.

In cast aluminum work, models are generally made of coarse ground asbestos and plaster, in the proportion of three-fifths of the former to two-fifths of the latter. Soapstone, powdered silex, pumice stone, marble dust, sand and various other materials, as well as asbestos, are also employed for this purpose, and there are also a number of investment compounds on the market, some of which have undoubted merit, but good results can be secured by using the mixture mentioned. This can also be successfully employed for models when Watts metal, or weighted lower dentures, are to be cast.

Models for Die Construction.

126. When models are to be used for die-making there are certain requirements to be fulfilled. First, the base on which they rest should be flat; second, the model should be so flared as to part from the sand matrix without distorting it; third, the anterior part of the model should be slightly elevated, sufficiently to throw the thinnest part of the palatine or lingual

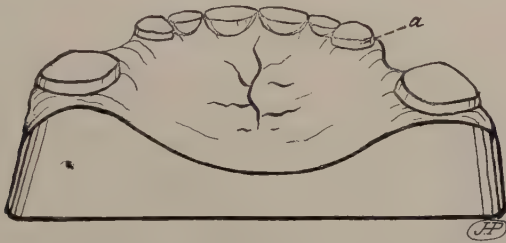


FIG. 22.

portion to the extreme distal margin of the model, Fig. 24a. The object of this will be explained when treating of sand matrices; fourth, the model should be as thin as possible, to be consistent with strength. It is a well recognized fact among brass molders that sharper and more accurate castings can be secured from the use of thin models than where thick ones are employed. In partial cases the models must not only be

trimmed peripherally, so as to flare, but the remaining teeth must be cut off square, from 1 to 2 mm. from the gingival line. Fig. 22a. The lingual surfaces of the remaining portions of the teeth should not be trimmed nor molested in any way unless this is found necessary to insure their removal from the sand.

127. In lower partial cases, where the anterior teeth are present, the plaster teeth should be cut off about the incisal third and the plate allowed to run over and rest upon the cingulum, and thus furnish the necessary stability and support to the denture. If a denture of any class is trimmed so as to have only a slight bearing upon the anterior teeth, its constant movement during mastication will produce irritation of the soft tissues at the gingival line, and result is ultimate loss of the teeth.

128. After trimming off the plaster teeth, any depressions

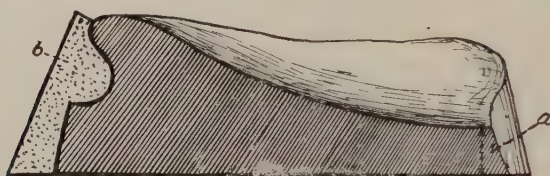


FIG. 23.

on the labial or buccal surfaces of the model that are not involved in swaging or fitting the denture can be filled in with plaster, and the proper flare given to these surfaces to permit the ready removal of the model from the sand. Sometimes a hard quality of wax is melted into depressions to give the proper contour, being afterward varnished to insure separation.

Cores.

129. When it is desired to reproduce undercut surfaces in the die, the model is given its general outline and the flared base smoothed up with the fine sandpaper. The surface containing the undercut is now varnished with some separating medium and a mixture of half and half coarse ground asbestos and plaster is made, and built against the undercut and entire side of model, from border to base, and covering the entire undercut surfaces, Fig. 23b. It should be from 8 to 10 mm.

thick. When set, the surplus is trimmed away, finishing the margins of the "core," as it is called, abruptly against the model, yet in such manner that they will part readily from the sand. The core is now removed and supported over a burner, so as to prevent warpage, and gradually dried out. When dry it is placed back against model ready for use. In lower cases it is frequently necessary to construct cores for the lingual surfaces of models on account of the general divergence downward and outward of the mandible, especially in the molar and bicuspid region.

The Hawe's molding flask can frequently be used for securing an accurate sand matrix without the use of cores. See paragraph 341.

Evan G. Richards.
Chicago - 1906.

CHAPTER VI.

Movements of Lower Jaw—Muscles of Mastication—Securing the Occlusion or “Taking the Bite.”

130. There is perhaps no step in the construction of artificial dentures more important than that of securing the normal relation of the lower to the upper jaw, ordinarily called “taking the bite.” That it may be thoroughly understood it is necessary to be familiar with the anatomical structures and the mechanical movements and geometrical form of the mandible. The lower jaw is a strongly formed bone, consisting of a horizontal portion or *body*, curved from side to side, and two perpendicular portions called the *rami*, which join the body at the back part. In very young and very old people these rami join the body of the bone at a considerable angle, but in the average adult these portions of the mandible form almost a right angle to the horizontal portion or body. Surmounting each ramus are two processes, the anterior one of which is the coronoid, and the posterior the condyloid. The condyloid processes articulate with depressions in the temporal bones called the glenoid fossæ.

131. The condyloid processes are oblong in form, their long axes being transverse, and set upon the necks that connect them with their rami in such a way as to throw their outer ends a little higher and more forward than the inner ends. They are convex from before backward as well as from side to side, thus forming an admirable articulating surface. The articulated condyle, when in position, sustains this relation to the glenoid fossa; first, the synovial membrane lines the fossa; second, the interarticular fibro-cartilage, a thin plate of oval concave form and somewhat larger than the articulating surface of the condyle, lies against this synovial sac; third, a second synovial sac is interposed between the interarticular fibro-cartilage and the condyle, and, lastly, attached to the periphery of the condyle and extending to the margins of the

glenoid fossa are the fibers of the capsular ligament. These various structures and tissues do not hold the condyles closely in their fossæ, and therefore the lower jaw is capable of diversified movements, brought about by the various muscles which find insertion on this bone.

Muscles of Mastication and Movements of the Mandible.

132. The *opening* of the jaw is accomplished by the combined action of the digastric, the platysma myoides muscles and gravity; *protrusion*, by the external pterygoid and the superficial part of the masseter muscles; *lateral motion*, by the external pterygoids acting independently and alternately, drawing the jaw forward and to the opposite side; *closure* is accomplished by the action of the temporal, masseter and internal pterygoid muscles. The lower jaw is subjected to all these movements, as well as modifications of them, in the mastication of food, and it is very necessary that the prosthetist should thoroughly understand them. Further information along this line can be obtained by referring to the text-books on anatomy.

133. In taking the bite the condyles should be at rest in the glenoid fossæ. This is considered the normal position, for when not subjected to movement the muscles and ligaments draw the condyles up in this position.

134. In partial cases, where some of the natural teeth are present in both jaws, and in occlusion, the normal position of the lower jaw is easily determined, since these teeth guide it to proper place without difficulty. When, however, the teeth have all been lost, in one or both jaws, this relation is much more difficult to determine. The most accurate method in vogue at present consists in constructing base plates upon which are built rims of wax, corresponding in length to the crowns of the lost teeth, and by trial determining the normal relation of the condyles to the glenoid fossæ and of the alveolar planes to each other. The models having been secured, the next step will be the construction of the base plates.

Forming the Base Plates.

135. These are commonly formed from some material that is rigid enough to retain its shape when subjected to the temperature of the mouth, as well as the stress which the base

plates will be required to withstand in fitting. Ideal base plate is perhaps the best for this purpose, as it fulfills both of these requirements. It is somewhat difficult to adapt to models, and for this reason its use is objected to by some. If handled properly, however, it can be conformed to any model and will

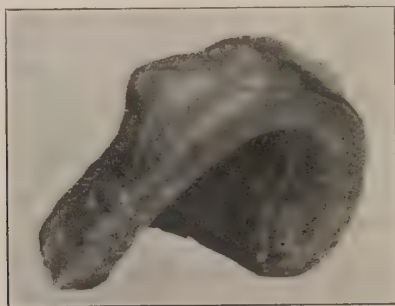


FIG. 24.

give most satisfactory results. It should be heated in a Bunsen or alcohol flame and the surface *not* having been brought in contact with the flame applied to the model. This plan is preferable to heating the base plate in water, a method recommended and frequently followed. Usually two or three heatings will be required to perfectly conform it to the model.

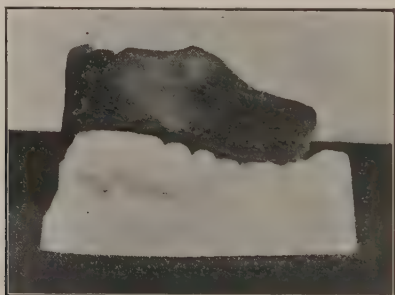


FIG. 25.

When perfectly adapted its periphery should be trimmed to approximate that of the denture to be constructed.

136. A roll of wax about 10 mm. in diameter is now placed around the ridge and directly over it. The buccal and lingual surfaces of the roll should be burnished with a warm spatula

until these are flattened and made parallel with each other; the surface representing the line of occlusion should be flattened, and present a face from 10 to 15 mm. broad. This plane should be somewhat curved from before backward, as it represents the location or position the incisal and occlusal ends of the artificial teeth will occupy when arranged on the base plate. Fig. 24 shows a full upper base plate. In full upper cases the rim of wax should be so adjusted that in the closure of the jaws all of the teeth which remain in the lower jaw may bear uniformly against it. (See Fig. 25.)

137. It should also be of the proper length to represent the length of teeth. If too long and bulky and the teeth are arranged correspondingly, they will be exposed to view at all times; if too short, they will not become visible to any extent, even in speaking and laughing. The length is determined by fitting the base plate in the mouth.

Fitting Full Upper Trial Plate.

138. The wax rim, having been properly adjusted, the plate is introduced into the mouth. There are seven points of special interest to be noted:

First—Mark proper length of lip on wax rim.

Second—Secure perfect and uniform contact of wax rim with the opposing teeth or base plate.

Third—Restore proper facial contour.

Fourth—Mark median line of face.

Fifth—Mark high lip line.

Sixth—Establish normal relation of lower to upper jaw.

Seventh—Adjust the face bow.

Proper Length of Lip Line.

139. In the first point mentioned, the wax rim should be trimmed, if too long, or added to, if too short, until it coincides with the upper lip when the latter is relaxed and resting naturally on the face of the wax. The position of this line, located on the rim, at this time, will subsequently serve as a guide in the arrangement of the teeth, the incisal ends of the six anterior ones being placed even or on a horizontal plane with this surface of wax, while the occlusal surfaces of

the bicuspid and molars occupy a like relation in their position to the posterior rims of wax. If the rim is too long and constantly exposed to view, except when the patient, by an effort, draws the lip down over it, the teeth, when arranged, will occupy a similar relation, which is contrary to normal conditions. If, on the other hand, the rim is too short, the teeth will scarcely become exposed to view when the lip is drawn up and contracted, as in laughing, a condition which, while not as objectionable as the first, is not normal, is decidedly unsightly, and should be avoided. This line having been determined by trial, the wax is trimmed to it.

Uniform Contact of Teeth with Wax Rim.

140. The lower incisors should come in contact with this trimmed surface, while the molars and bicuspid should also come in contact with and exert equal pressure upon the wax rim opposite their respective positions. Frequently there will be *apparent* contact of the rim with the teeth in the opposite jaw, when in reality the base plate has tipped or been thrown away from the mucus surfaces by stress exerted on the opposite side of the mouth. This is due to the wax being of insufficient thickness on the side thrown down, or too thick on the opposite side. This condition can be determined by instructing the patient to keep the teeth firmly in contact with the rim of wax, and while this contact is maintained by the patient, an instrument should be inserted in the wax rim, at various points, and pressure exerted in the direction of the border. Under this stress the plate will yield if not in proper contact with the process, and the fact can readily be noted. Let me emphasize once more this point, *the bearing of the teeth in the lower jaw against the wax rim of the base plate must be uniform*. Failure to secure this condition at this time will result in imperfect occlusion of the finished denture.

Restoring Proper Facial Contour.

141. Next to securing perfect and uniform pressure of teeth against the base plate, this step is the most important. It is usually necessary, where alveolar absorption has progressed to some extent, to add a considerable thickness of wax to the rim in the region of the cuspid eminences, but, as before

intimated, this is entirely governed by the amount of absorption that has occurred. The unsightly wrinkles that often form on the face, after loss of the teeth, beginning at the alæ of the nose and extending downward and outward over the angles of the mouth, can in almost every instance be removed by properly building up and contouring the denture under this surface.

141a. It will seldom, if ever, be necessary to thicken a base plate above the lateral incisors, for the reason that in the largest percentage of cases there is a natural fossa or depression in this region, called the incisive fossa, and the lip, if thrown out at this point, would appear unsightly.

The cuspid eminences can usually be built out prominently and by this means the wrinkles mentioned can be obliterated. Here is the opportunity for the prosthetist to display his esthetic faculties, and he who does so judiciously not only receives the heart-felt appreciation of his patients, but proves himself worthy of his calling—*a master of his art.*

142. These remarks in regard to facial restoration, etc., properly belong under the "arrangement of teeth," but as the manner in which the base plate is constructed serves to a great extent as a guide in arrangement, the subject has been introduced here. At times it is quite necessary to thicken to a considerable extent the margin of the base plate over which the buccal muscles reflect, forming what are commonly known as "plumpers," in order that depressions which have appeared in the cheeks after loss of the teeth may be obliterated. Do not fail to note that attempted restoration should be made while securing the occlusion. If in trying in the arranged and occluded teeth, improvement can be made, so much the better, but as a rule too little time is devoted to this step, and its importance is too often overlooked.

Marking the Median Line.

143. It is a peculiar but well-noted fact that few faces are symmetrically balanced. There is frequently a marked difference in the shape or position of the eyes, the eyebrows, the malar eminences, or in the prominence of the angles of the lower jaw, but by far the most common and noticeable departure from symmetry is in the nose. This feature of the

face is *as a rule* twisted or bent to one side or the other. Rhinologists have noted that the nasal septum is generally deflected to one side, usually to the left, and this may account for the irregularity of the tip of the nose. However this may be, it is certain that in locating the median line of the face it must not be established according to the nose. The labial frænum is also a little to the left of the center, and that cannot be depended upon to give the correct location.

144. The most accurate way, for a beginner at least, is to bring to his aid a straight edge, applying one edge to the perpendicular median line of the face. Note the median line of the chin, the central dip or curve of the upper lip and the tip and root of the nose where the nasal bones join this process of the frontal. Strike a general average of all of these points and mark the median line on the wax rim accordingly, and the result will at least be harmonious, if not absolutely correct. If located according to any one of these points and an irregularity does exist, it becomes more or less pronounced. With experience, the straight edge can be laid aside and accurate results secured with the eye alone. The best position for locating this point is to stand directly in front of the patient. The chair should be sufficiently elevated to bring the patient's face on a level with that of the operator. After marking the line on the wax instruct the patient to raise and again relax the upper lip a number of times until thoroughly satisfied that the correct point has been located.

Height of Lip Line.

145. This refers to the position the lip assumes when drawn up or contracted, as in laughing, and is shown in Fig. 31 by the line located midway between the peripheral margin or termination of the upper trial plate and the junction of the two base plates. The median line is also indicated by the perpendicular line crossing the two base plates. It is essential to mark the curve the lip assumes, as it serves as a guide in selecting teeth of proper length for the case. This subject will be taken up later on, so that we will confine our attention to locating the line on the wax rim. The patient should be instructed to contract the lip to the greatest possible extent, and while in that condition a small instrument should be used to mark the

curve and extent of the lip line. This should be repeated a number of times until the operator is satisfied that the highest possible point of contraction has been reached.

Establishing the Relation of Lower to Upper Jaw.

146. These various steps having been successfully accomplished, the next one in order will be to secure the combined impression and bite of the opposite occluding teeth. The base plate is first removed from the mouth, chilled in cold water and the moisture all removed from the occlusal face of the wax rim. A roll of wax about 10 to 15 mm. in diameter, and rendered quite plastic by heat, is now placed on the wax rim occlusally, and pressed sufficiently to unite the two. The base plate, with the wax added, is again introduced into the mouth and the patient instructed to close the lower jaw, the operator in the meantime exerting steady, firm pressure on the point of the chin, so as to depress the condyles in their respective sockets. The pressure exerted by the patient should be sufficient to force the teeth entirely through the softened roll of wax until they come in contact with the chilled rim, which, of course, should stop them. Instruction is now given the patient to press the tongue evenly against the lingual portion of the softened wax, the operator at the same time pressing upon the labial and buccal portions to insure a more perfect impression of these surfaces of the teeth. After introducing the base plate with bite wax attached, and before the patient closes, the operator should see that the roll of softened wax is properly placed, so that the teeth in entering it will about evenly divide it, thus insuring a sufficient amount lingually as well as labially and buccally for accurate impression service.

Adjusting the Face Bow.

147. The face bow is an appliance for securing the relation of the alveolar planes to the condyles when the latter are at rest in the glenoid fossæ. It is so constructed that the models, when secured, can be mounted on the occluding frame in exactly the same relation to the hinge that the occlusal planes of the border sustain to the condyles. It is a well-known fact that in normal occlusion the teeth in the lateral motions of the jaw are in contact, not only where the incisal lines cross each

other, but the *molars and bicuspid*s of both sides are also in contact to a greater or less extent. It is possible by securing the same relation of alveolar planes of models to hinge of occluding frame that the natural planes sustain to the condyles to arrange artificial dentures so as to secure *three general points of contact*. The advantage of such an arrangement is apparent. When morsels of food are being crushed between the molars and bicuspids on one side, if the teeth of the opposite side are in contact at the same time, the tendency to tip will be overcome and greater stress can consequently be exerted in mastication.

This subject will be enlarged upon later in describing the

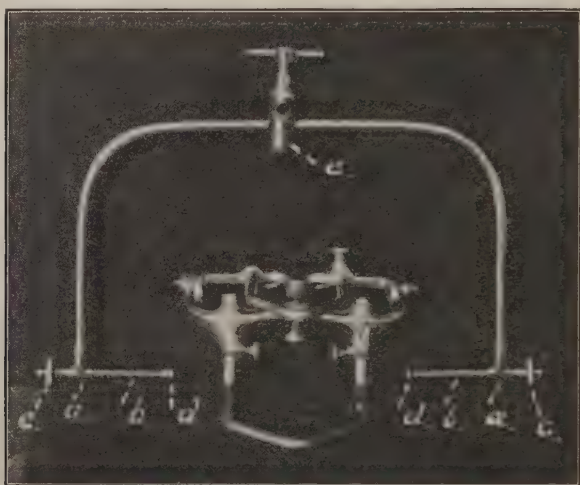


FIG. 26.

arrangement of the teeth. At present we will confine our attention to the details of securing the proper relation of planes mentioned by means of the face bow.

148. This appliance consists of a wide, U-shaped bow of metal, sufficiently rigid to withstand the stress to which it will be subjected, without springing. (See Fig. 26.) It is perhaps 12 *cm.* wider between the points *a.a.* than the average human face. The rods *b.b.*, with the cup-shaped projections on their inner ends, are adjustable by sliding in and out and are retained in any position desired by the clamp and milled nuts *c. c.*

149. The cup-shaped points on the ends of the rods are designed to press against the external ends of the condyles. The rods are graduated so that the face bow may be evenly balanced when in position. In setting, care should be taken that the same number of graduations show on the inner end of each rod. The bow is sufficiently deep to pass in front and 10 or 12 *cm.* from the face. On the bow, and in the center, but capable of adjustment, is a double clamp contrivance, *e*, both clamps actuated by one set screw. Into or through the lower clamp a rod about 10 *cm.* long passes, carrying on one end a crescent-shaped plate of metal, which is inserted into the wax bite.

150. The method of using is as follows: The roll of softened wax, having been conformed to the lower teeth, the



FIG. 27.

U-shaped end of the rod is heated and pressed into the wax rim. It should not be overheated or the wax will melt and burn the lips, but enough heat should be applied to enable the plate to be readily pressed into the rim. The rod itself should be about at right angles to the facial line. The face bow is now carried up to place, the clamp in the center slipped over the rod projecting from the wax, the two sliding rods on the end of the face bow carried into position over the condyles and pressure made upon them until they firmly hold the bow in correct position, when the clamp nuts can be tightened. The ends of the condyles are usually about 12 *mm.* from and horizontally in front of the external opening of the ear. They can easily be located by pressure of the finger. After setting the rods evenly, and so that the pressure is uniform and suffi-

cient to hold the bow in position, instruct the patient to produce firm pressure on the base plate with the lower jaw, and while this is maintained the screw actuating the clamp device is tightened. (See Fig. 30.) This not only tightens the clamp against the rod, but also holds the rod in that exact relation to the face bow that it now sustains.

The side clamps are now released and the rods pushed outward, the patient instructed to open the mouth, and the face bow and rod, with the base plate attached, removed. If the details have been carefully attended to, the various parts will come out in proper relation to each other. The method of mounting on the occluding frame will be given later.

Full Upper and Lower Base Plates.

151. The method of procedure in these cases is similar in most respects to that just outlined for full upper cases. The lower base plate should be built up with a wax rim similar



FIG. 28.

to the upper, the facial contour noted and the length of lower lip line, both normal and low, marked on the rim. Care should be taken to see that the base plates *do not tip*, but that the pressure of the alveolar planes upon base plates and wax rims is uniform throughout. When all the conditions heretofore noted have been fulfilled, the patient is instructed to open

and close the mouth a number of times in succession, the operator carefully watching the relation of the two rims of wax when in contact. Pressure should now be made upon the chin to see if the relation of the rims is changed thereby. When the correct relation has been determined the two base plates are attached together. This is usually accomplished by means of small wire staples pressed into the wax, as indicated in the diagram. They should be set in pairs and opposite, so that the relation of the planes may be maintained. It is frequently a good plan to heat the point of the spatula and melt the two rims slightly at their line of junction, yet not enough to destroy their form to any extent. The face bow is applied in the manner just described for full upper cases, inserting it in the wax rim of the upper base plate.

Taking the Bite in Partial Cases.

152. When some of the natural teeth remain in occlusion and only a few are missing a roll of wax is softened, placed in the mouth and the patient instructed to close or bite through it. In most cases it is best for the operator to exert firm pressure on the point of the chin, in the direction of the condyles, at the same time instructing the patient to relax the muscles. Usually if the patient's assistance is enlisted to any extent the bite will be incorrect, and for that reason the operator should rely on his own efforts and judgment. In many partial cases base plates can and should be constructed, and the face bow used to secure proper position of models on occluding frame.

153. When models are arranged on occluding frames by guess there is not one chance in a thousand that they will be correctly placed. While the artificial teeth may be properly *occluded*, even when the models are not correctly placed, yet in the lateral motions of the jaw the teeth on the finished denture will rarely, if ever, be found in correct position or of proper length, a condition that always calls for more or less grinding while fitting the substitute in the mouth. These defects can be overcome if the steps as laid down are properly carried out.

Mounting Models on Occluding Frame.

154. The sliding rods on the ends of the face bow are pushed in as far as they will go and the milled nuts *c.c.* tightened. The upper bow of the occluding frame is opened and the

depressed cups on the ends of the rods are fitted to the projections on the outer ends of the hinges. The base plates are, of course, still in position on the face bow and are placed between the upper and lower bows of the occluding frame, as shown in

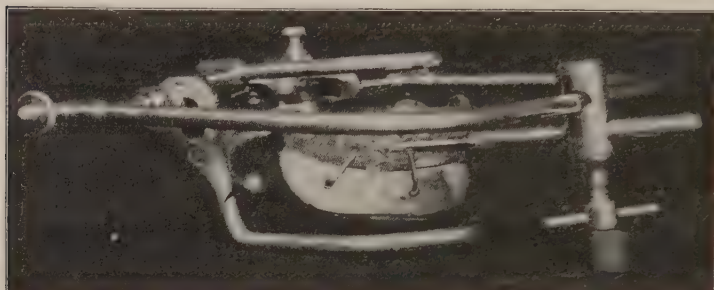


FIG. 29.

Fig. 29. The models are now placed in position in the base plates, the upper bow dropped down upon the upper one, the lower resting upon the lower bow, and the two attached with a mix of plaster. If an upper case only, the upper model should

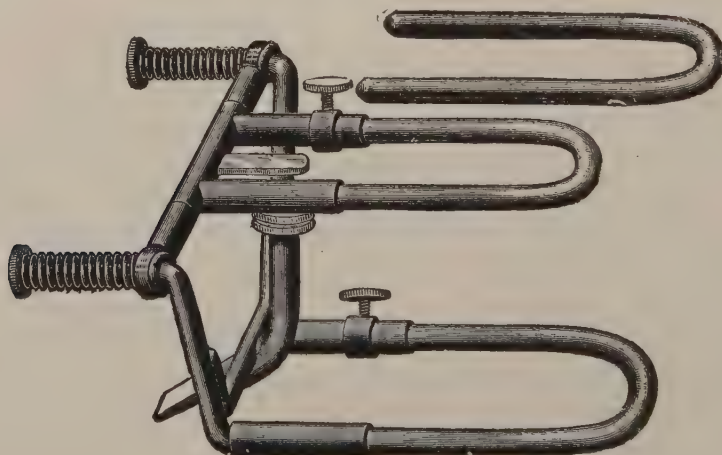


FIG. 30.

be attached first, the wax bite oiled and plaster poured in it in the ordinary manner, building it down sufficiently far to meet the lower bow of the occluding frame to which it is attached. When set, the wax bite should be separated from the wax rim

of the base plate, the face bow removed by loosening the clamp screw attached to the base plate rod and springing the bow over the projecting hinge spurs or loosening the rods. The bite rod, still attached to wax rim, is removed by warming slightly, the base plate and bite are pried apart, the wax bite is removed from the lower model by heating and the case is mounted ready for the arrangement of the teeth. In full upper and lower cases the upper model is mounted first in the manner just described; the lower model is placed in its base plate and attached the same as outlined for the upper to the lower bow of the occluding frame. The face bow is removed, the staples are withdrawn and the base plates pried apart at their line of contact. Fig. 33 shows models in the base plates ready for attaching to frame.

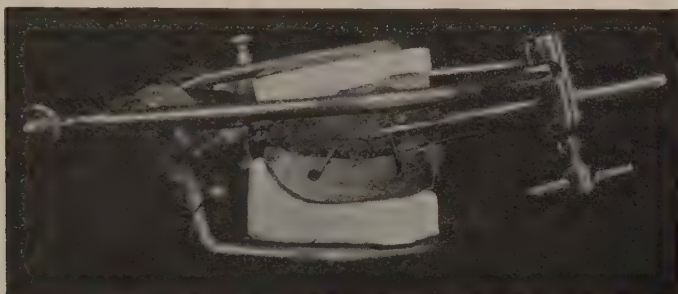


Fig. 30 shows the form of the Improved Bonwill Articulator, which, with the exception of the set screw for controlling the position of the jaws, is the same as originally designed by the late Doctor Bonwill.

CHAPTER VII.

Selection of Teeth.

155. Artificial teeth are divided into two general classes, plain teeth and gum section teeth. Both of these classes are usually furnished with platinum pins, to afford means of attachment to the substitute. They may again be divided into two classes—teeth with headed pins, designed for use with plastic bases, and “long-pin” teeth, the pins having no heads, designed for use in metal work. When the pins are placed in a line at right angles with the long axes of the teeth they are called “cross-pin” teeth, to distinguish them from those in which the pins are placed in a line parallel with the long axes.

Gum Section Teeth.

156. These teeth represent not only the crown portions of the natural teeth, but beginning at their cervices, and extending



FIG. 31.

rootwise, is a section of porcelain, overlaid with pink enamel, representing the gums. As a general rule the porcelain gum approximates very closely in color and contour the natural tissues—much better, in fact, in point of shade, than any other material in use—and were it not for certain objections gum sections would be used much more frequently than they now

are. The principal objection is due to the fact that the teeth, being in sections, cannot be so perfectly adjusted to the opposite occluding teeth as can plain teeth; or, in other words, since the teeth come in sections of twos, threes and fours, the range of their adjustment is limited. The second objection is on account of the difficulty in grinding the ends of the sections so as to insure perfect joints, and thereby prevent the ingress of the plastic base while the flask is being closed. Should any of the basic material be forced between the ends of the sections, the joint shows a dark line more or less unsightly. Fig. 31 shows the ordinary forms of teeth of this class.

Plain Teeth.

157. Plain teeth are always single, not being made in blocks or sections, as are the preceding ones just described. Those designed for plastic work are made with a shoulder on the

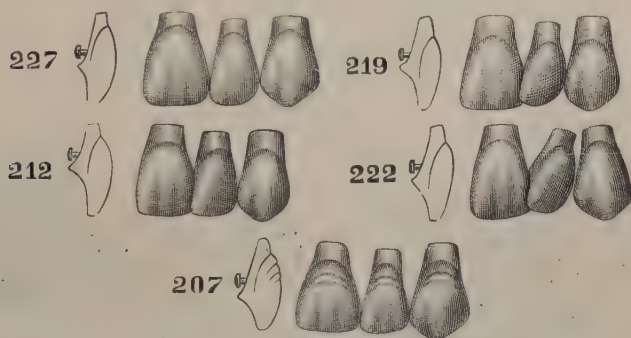


FIG. 32.

lingual side, against which the vulcanite or celluloid should be finished. The pins are placed between the shoulder and cervical end of the tooth. These teeth are perhaps more universally used than those of any other class, because each tooth being independent, it can be rotated, shortened, elongated or placed at any angle that proper occlusion with the opposite teeth requires. Fig. 32 shows the ordinary forms of these teeth.

Miscellaneous Teeth.

158. Under this head may be classed pinless or diatoric teeth, continuous gum teeth, saddle-backed teeth and counter-sunk pin teeth.

Diatoric or pinless teeth are made in a variety of forms for use on plastic bases. They are retained in position by dove-tailed projections, or holes formed in the lingual side of the porcelain, around or into which the plastic material is molded. Some of the ordinary forms of these teeth are indicated in Figs.

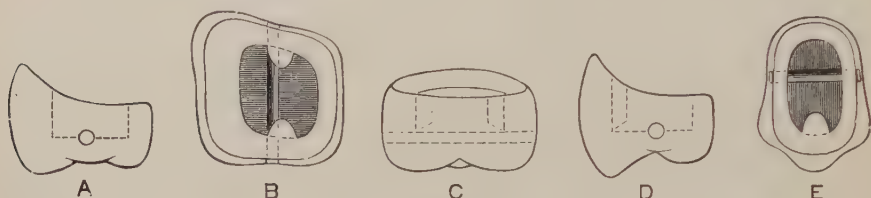


FIG. 33.

33 and 34. These teeth are not suitable for partial cases where single teeth are to be fitted between remaining natural ones, since the means of retention, being of porcelain, and more or less bulky in order to insure strength in this material, reduces the amount of plastic base surrounding the attachment to an insufficient amount for retention purposes. In full cases pinless teeth can frequently be used to good advantage.

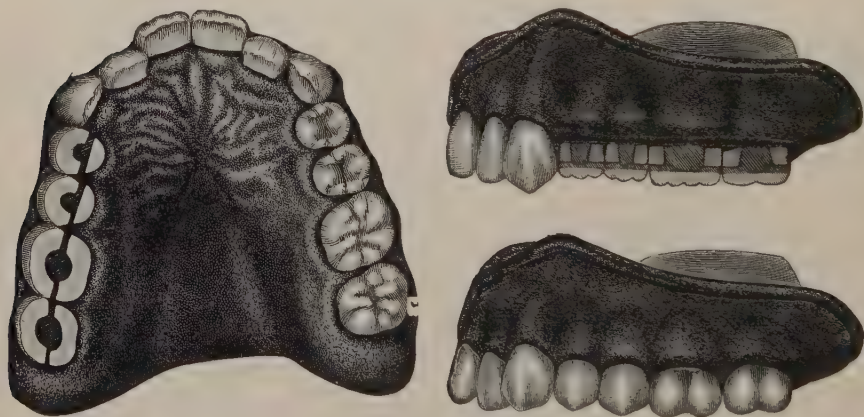


FIG. 34.

159. *Continuous gum* teeth are designed for use in porcelain work. They represent not only the crown portions of teeth, but flattened projections representing portions of the roots as well. These afford support for the teeth by resting upon the platinum base during the backing of the body. The

pins in these teeth are much longer and heavier than those in the ordinary forms, so that they may be bent to lie in contact with the platinum base to which they are attached by soldering. (See Fig. 35.)



FIG. 35.

160. *Saddle-backed* teeth are really a modified form of short shut teeth and are designed to be used where teeth of the latter class are indicated. (See Fig. 36.) These teeth can fre-



FIG. 36.

quently be used to good advantage in constructing crowns and dummies for bridges, as well as in plastic base work.

161. *Countersunk pin* teeth can only be used where considerable absorption of the alveolar border has occurred. In



FIG. 37.

favorable cases dentures constructed of these teeth present a very fine appearance, since much more of the lingual surfaces are represented in porcelain than in the ordinary forms. The pins are placed in a countersunk depression in the ridge lap,

leaving the surface ordinarily occupied by the pins free, thus enabling this surface to be contoured with porcelain. (Fig. 37.)

Proportionate Parts of Teeth.

162. In selecting a tooth for any case attention should be given to the shape and angle of its cervical end or "ridge lap," the "shut" and the "bite." (See Fig. 40.)

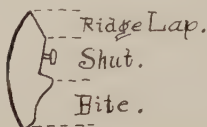


FIG. 38.

"Ridge Lap."

This term refers to the extent of surface contact of the cervical portion of a tooth with the alveolar process, which varies in different teeth and designated by short, medium or long ridge lap, as indicated in Fig. 39. When the alveolar border is prominent, but slightly absorbed, and the lip line



FIG. 39.

is high, teeth with long ridge lap, *a*, should be used. When a considerable amount of absorption has occurred and but little, if any, of the ridge shows when the lips are contracted, teeth with short ridge, *c*, lap are indicated.

"The Shut."

163. This is not a very explicit term, but is one of long and common usage, and refers to the width or distance between the upper and lower alveolar processes, or between the incisal ends of the teeth of one jaw and the alveolar process of the opposite. (Fig. 40.) The *shut* of an artificial tooth is indicated by the

distance between the lingual shoulder and the angle formed by the ridge lap with the lingual surface of the tooth. The varia-



FIG. 40.

tions in the shut of different teeth are also designated as short, medium and long. (See *a, b, c*, Fig. 40.)

"The Bite."

164. The bite, or overbite, rather, when applied to artificial teeth refers to the distance between the incisal end of a tooth and the lingual shoulder. (Fig. 40.) In selecting teeth especial care must be given this point, since in upper cases if a tooth of too short a bite be selected, in fitting to the case, the lingual shoulder will very likely be ground away in order to secure proper occlusion, and the attachment of the tooth to plate be weakened because of the small amount of basic material covering the pins at this point. In case of lower anterior teeth, if the teeth selected have short bite, there will be an unnecessary amount of basic material required to give proper lingual contour, thus rendering the plate bulky at the very point where the tongue requires plenty of space.

The terms long, medium and short bite are used to designate the variations in this portion of a tooth. (See Fig. 40, *a, b, c*.)

Flat and Bow Faced Teeth.

165. Flat-faced teeth are designed to be used on a protruding edentulous ridge. (Fig. 41.) Bow-faced teeth are used on



FIG. 41.

FIG. 42.

an edentulous ridge when the teeth in the opposite jaw protrude. (Fig. 42.) These terms refer to the amount of curvature of the labial faces of teeth.

Selection of Teeth for Partial Cases.

166. In partial cases where but little absorption of the alveolar border has occurred, and no gum restoration is necessary, plain teeth should be selected and ground to accurately fit the tissues. If teeth of suitable form to correspond to the remaining natural ones have been selected, and are properly ground and placed in position, they will have the appearance of natural teeth, surrounded at their cervices by soft tissue. The model should be trimmed slightly, *after the teeth have been ground to fit it*, so that the teeth, when fitted in the mouth, may imbed themselves to a slight extent in the gums. In partial cases where gum restoration is necessary, especially in the anterior part of the mouth, gum section teeth should be selected and the sections ground at the expense of the lingual side of the block, so that the labial or buccal contour, when restored, will correspond with and replace the amount of absorption of border which has occurred. *If the labial or buccal face of the block projects beyond the original line of gum contour it becomes at once noticeable and unsightly.* Care should also be taken that the artificial gum at its junction with the natural tissues be thin, delicate and in absolute contact with this part in order that the presence of the block may not be apparent. If the mesial or distal margins of the section are bulky and square, or bluntly rounded, the line of junction is readily detected, not only on account of the break in the continuity of the surface, but the ends of the sections, not being covered with pink enamel, will show a white line.

167. When the four incisors are to be replaced and gum restoration is necessary, a single gum section block carrying these four teeth can frequently be used, thus obviating the joint at the median line. A block of this length, however, is apt to break easily under stress, and care should be taken in packing and closing the flask to reduce the pressure to the minimum.

168. Plain teeth, with pink vulcanite gums, should seldom be used in partial cases in the anterior part of the mouth, because of the very noticeable contrast in color between this ma-

terial and the natural tissues. When, however, in the contraction of the lips, if the gums are not exposed, pink vulcanite may be used if desired. Unfortunately, up to the present time no pink rubber has been produced that approximates very closely in color the natural tissues.

169. In replacing bicuspid and molars, plain teeth with gum restoration of pink vulcanite can frequently be used to good advantage. Gum sections, however, are very applicable in such locations and should be used when the gum is visible (see Fig. 43). Special care should be taken to make the line of junction with gums delicate and with a long bevel, and if possible, a little less prominent at this point than the natural tissues originally were. In all partial cases the contour, continuity and alignment of surfaces of the artificial with the natural gums

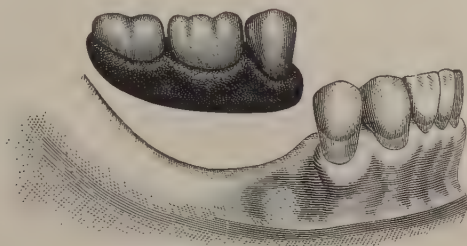


FIG. 43.

must be secured if æsthetic results are desired. The selection of teeth for partial cases is usually not a difficult task, since the remaining natural ones furnish a guide as to shade and form. In addition to the points already mentioned, viz., ridge lap, shut and bite, teeth of proper width to insure proximate contact, of correct labial or buccal contour, of suitable width at cervices and of accurate mesial and distal curvature should be selected to harmonize with the natural organs.

Selection of Teeth for Full Cases.

170. When selecting teeth for full cases the general form and size of the arch furnishes a guide as to width of teeth to be used. The outer surface of the wax rim of the base plate represents the line to which the labial and buccal surfaces of the teeth are to be adjusted. The cuspid eminences on the wax rim indicate the position of these teeth, and a set of teeth,

the six anterior ones of which will neatly fill this space, should be selected for the case.

Frequently, in full cases, where but little absorption of the alveolar border has occurred, especially in the anterior part of the mouth, plain teeth may be ground to the gum as described in paragraph 166, and thus obviate the use of an artificial gum, when it is contra-indicated (see Fig. 44).

171. The length of the teeth depends upon two conditions—first, upon the temperament of the patient, and, second, on the distance between the incisal surface of the wax rim and the

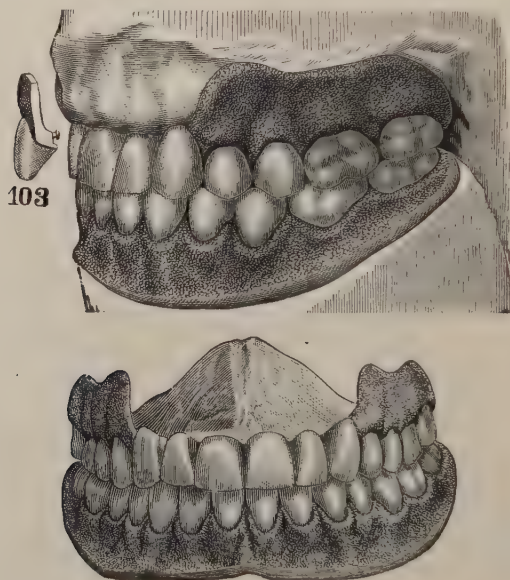


FIG. 44.

high lip line. The subject of temperaments will be taken up later, so that at this time we will only mention the fact that in all persons of a certain definite temperament the teeth have a certain definite form and a relative proportion as to width, length and color. The width having been determined by the size of the arch, teeth of that width and of proper form and shade to correspond to the temperament are selected, with the result that the length, for that particular form, will be proportionate to the width.

Fig. 45 shows a case of protrusion of the lower jaw. In

such cases teeth with constricted necks should be selected, since the arc of the circle described by the necks is smaller than that described by the incisal ends.

172. When the temperament of the patient cannot be determined, and in many cases this is a difficult matter, the high lip line will often serve as a guide in selecting the length of teeth suitable for the case. The distance between this line and the incisal surface of the wax rim indicates, in many cases, the correct length of teeth to be used. It may be stated that, as a rule, the teeth selected should be as long as can possibly be used, to be consistent with the harmonious appearance of the

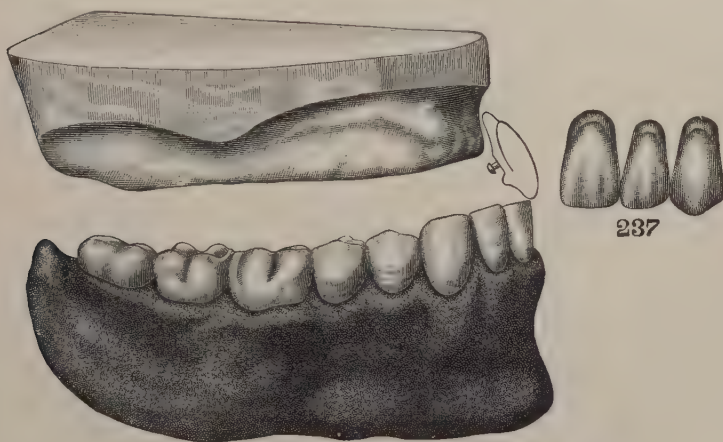


FIG. 45.

features, in order that the least amount of artificial gum may be exposed in the contraction of the lips. It naturally follows that with a given distance from the incisal surfaces of the teeth to the reflection of the orbicularis muscle, the greater the length of teeth used, the less amount of gum exposure is made in the contraction of the lips. Sets of teeth in which the bicus-pids and molars are of approximately normal size and form are to be preferred to those in which these teeth are undersized, since if these occlusal surfaces are limited in area the use of the denture in mastication will be impaired.

Temperaments.

173. When cases are presented in which all of the natural organs have been lost the selection of artificial teeth which will

harmonize in size, form and color with the patient's general complexion is a matter of prime importance, requiring close study and careful consideration. If the teeth selected do not fulfill the proper requirements the artificiality of the substitute when introduced in the mouth becomes more or less plainly apparent.

The natural teeth in different individuals vary greatly as to size, shape and shade, and a set of teeth which would look well in one mouth would, if introduced in another, be glaringly inappropriate. In addition to the variations of the teeth mentioned we find that the color of the eyes and hair vary, and the the general complexion and contour of the face and body are different. These facts have been recognized for centuries by those who have made a study of man, and attempts were early made to classify into a few groups those who presented the marked characteristic differences just mentioned. These classes are termed temperaments, and are supposed to represent the variation in bodily organization as manifested in outward form. The first classification was made by Hippocrates almost two thousand five hundred years ago, and this has served as a basis for many of the modern systems. About one hundred years ago Dr. Spurzheim modified the older system, and his modification is used to a greater or less extent to-day.

174. The definition of the word temperament, as given by an authority on the subject, is "a special type of mental constitution and development, due to natural characteristics of bodily organization, often inherited; prevailing mental disposition or bias resulting from or accompanying such special bodily organization." The theory of Hippocrates was that temperament is conditioned on the predominance of one of the four humors—the blood, lymph, yellow and black bile. These modified the manifestations of the different organic functions, and the temperaments were accordingly classified as sanguine, lymphatic, choleric or bilious and melancholic or atrabillious.

175. The *sanguine temperament* is indicated by physical vitality, irritability, energy of action, tendency toward nervous exhaustion.

The *lymphatic temperament* is characterized by mental sluggishness, pale complexion, dullness of passionate emotion, flabby muscles, poorly organized generally.

The *bilious*, by the predominance of the nutritive system, dark complexion, muscular activity, energy, firmness of purpose, passionate disposition.

The *melancholic* temperament characterized by irritability, brooding thoughtfulness, tenacity of purpose and obstinacy.

Another class has been added to these four called the *nervous* temperament, and indicated by an exceedingly sensitive, nervous organization, as shown by quick mental action and vivid emotions.

176. In more recent years Dr. Jacques classified the temperaments on what he considered more natural conditions, as follows: First, the *motive* or mechanical, relating particularly to the muscular and bony development; second, the *vital*, or nutritive, relating to the lymphatics, blood vessels and glands performing the functions of digestion; third, the *mental*, or nervous, the seat of which is in the cranium, but extending itself by nerve trunks and ramifications to every part of the body and furnishing the means of sensation and volition. Still other classifications exist, some of which perhaps are capable of a closer and more accurate application to the subject under consideration than the first ones given, but since the latter have been worked out and their application to the needs of the dentist clearly shown, we will confine ourselves to a modification of the Spurzheim system in which the *nervous* is substituted for the *melancholic* temperament.

177. It is a noticeable fact that teeth of a definite shade and shape are as a rule associated with hair and eyes of a given color, so that if the teeth are all lost, if one understands the laws of harmony in colors, but little difficulty will be experienced in selecting teeth of proper form and shade for edentulous mouths. The preceding table, taken from Dr. E. M. Flagg's very complete one, although given in a very abbreviated form, will, it is hoped, enable you to begin the study of this interesting and very important subject, in its relation to the selection of teeth.

178. The dental supply houses furnish porcelain *shade teeth*, usually in twenty-five or thirty different colors, arranged for convenience on rings, or bars, and these are usually used for selecting the proper shade. Since these teeth are ordinarily of the same size and shape they do not furnish a guide as to the

80
Classification
of
Temperaments.

Basal Tempera- ments.	Eyes.	Hair.	Teeth.	
			Color.	Shape.
Lymphatic.	Pale blue or gray.	Fine and silky, but without luster.	Pallid, opaque, or muddy yellow.	Poorly shaped, broad and flat.
Sanguine.	Blue, brilliant and expressive.	Blond-red or chestnut, seldom dark or black.	Cream-yellow, darker at neck.	Well proportioned, curved and rounded.
Nervous.	Light gray or blue, restless, often morbidly brilliant.	Fine, light and soft.	Pearl-gray, or blue tinge.	Long, conical and rounded.
Bilious.	Black or brown, small and piercing.	Coarse, dark, often black, and abundant.	Strong, brunze yellow.	Conical, long and angular.

proper form of tooth to use for all cases, so the judgment of the prosthetist must be exercised in deciding this point. The sample shades furnished by one manufacturer rarely ever correspond to those of another, so it is best when a certain shade of porcelain has been selected to purchase the teeth made by the manufacturer whose shade tooth was used, otherwise more or less difficulty will be met with in securing teeth of the exact color as shade sample. By introducing the sample tooth under the lip in the position the central incisors will occupy and noting the general condition of harmony with the complexion the proper color can easily be decided upon.

179. While the patient is in the chair it should be determined what *shape* of tooth should be used, whether broad, short, long or narrow; whether convex or flat-faced; whether constricted or broad at the cervix; whether ridged or lined, and whether the incisal angles and cusps should be sharp, angular and well defined or somewhat rounded and indefinite. All of these points should be taken into consideration and a definite idea formed as to what the case demands. This, of course, requires judgment and discrimination, and the exercise of these can only be acquired by close study and observation of faces and mouths in which the natural teeth are present. Begin now to acquire this most important knowledge, and while you may not be able to correctly place all the subjects of your studies into a particular class or temperament, you can note the form and shade of their teeth, color of hair and eyes, together with the general bodily and facial contour. Further and fuller descriptions and classifications of temperaments can be found in the American Text-Book of Prosthetic Dentistry, on page 578, in the very able article on this subject, written by Dr. A. H. Thompson.

CHAPTER VIII.

Arrangement of Artificial Teeth in Full and Partial Cases. Partial Dentures.

180. In selecting artificial teeth for partial cases the remaining natural teeth serve as a guide in the selection of artificial substitutes as to form, color and arrangement. Usually the selection and arrangement of substitutes is a comparatively simple task, but occasionally complications arise which render these steps extremely difficult and unsatisfactory. Some of those most commonly met with will be mentioned here:

181. First—When the teeth opposite the space to be filled have elongated from non-occlusion and occupy the space that properly belongs to the substitutes.

182. Second—Mal-position or marked irregularity of the opposing or proximating teeth.

183. Third—Abnormally wide or narrow spaces to be filled, due to gradual movement of the remaining natural teeth.

184. Fourth—Limited space occluso-gingivally.

The following suggestions for obviating, to a greater or less extent, the difficulties mentioned are here offered:

185. First—Elongated teeth can frequently be reduced by grinding to proper length, and it is considered justifiable practice to devitalize if necessary to accomplish this step.

186. Second—No definite rules of procedure can be formulated for the conditions mentioned under this head. General alignment must be secured as far as possible, buccally and occlusally, or incisally and labially. Frequently by grinding the cusp or a mesial or distal plane of an opposing tooth good alignment may be secured, when without such a step the substitute could not be placed in correct position.

187. Third—When the spaces formed by the loss of the natural teeth have been reduced by the proximating teeth moving toward each other such spaces may be widened by discing away the proximating surfaces of such teeth to a greater or

less extent as may be required. The disced surfaces should be highly polished to render them as nearly self-cleansing as possible, and thus obviate the susceptibility to caries. This condition is frequently met with in the anterior part of the mouth, as illustrated in Fig. 46*a, b*. In this case the right central incisor has been missing for some time and the approximating teeth have approached each other. By discing away, as indicated by the dotted lines *a, b*., the space is increased so as to admit a porcelain central of width corresponding to the reduced natural teeth. Any variation of the width of the pairs of the six anterior teeth, especially of the central incisors, is very apparent, and care should be taken to equalize as far as can be done without injury the width of these teeth.

188. When the reverse condition exists, viz., a widening of the space, the case is somewhat more complicated, for if a

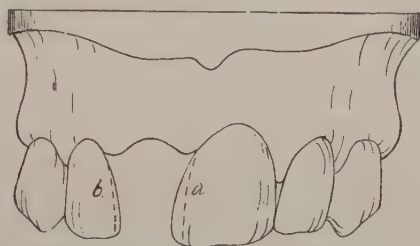


FIG. 46.

tooth be selected to fill the space the disproportion is immediately noticeable. When the space is only slightly wider than the natural tooth corresponding to the one to be replaced, the artificial tooth selected could be very little wider than the natural one and be placed so as to leave a slight space mesially or distally, as seemed most appropriate, between it and the proximating teeth. Sometimes the width of space is so great as to require two teeth to fill it, and, again, care should be exercised to obtain as harmonious proportions as possible.

189. *Fourth*—Sometimes there is so little space occluso-gingivally that porcelain teeth cannot be used with safety. In such cases metal teeth are frequently constructed and attached to the base plate the same as the porcelain substitutes.

190. As a rule, two very narrow teeth employed to fill the space occupied by a central incisor, when the remaining natural

one is wide, is more unsightly than a moderately wide one, set so as to leave a slight space mesially and distally. This rule, however, is not infallible, and the judgment of the prosthetist must be exercised in these as well as in all other cases in this line of work. These conditions have been mentioned because of their frequent occurrence and for the reason that the anterior teeth are always noticeable, and especial thought should be given such cases.

191. In the arrangement of artificial teeth for partial as well as full dentures, the model should be mounted on a lateral motion-occluding frame in order that the teeth, in partial as well as in full occlusion, may be noted, and so arranged as to take their proportionate amount of stress and no more.

Cases can be arranged on the ordinary "articulator" so as to occlude properly; yet, when fitted in the mouth, and the jaw is swung to one side or the other, some one tooth or cusp may be found to take all the stress of closure. When teeth are so arranged it becomes necessary, in fitting the plate in the mouth, to grind away those points that interfere with normal, partial occlusion, for if not done the denture is unfit for service in mastication, while the tendency to tip, under stress, is greatly increased. The grinding can be better accomplished before the teeth are attached to the base than at any other time; hence the necessity of using the lateral motion-occluding frame.

Arranging the Teeth in Full Upper or Lower Cases.

192. In the occlusion of a full upper or lower case only, it is supposed that the natural teeth are present in the opposite jaw or that a properly constructed plate is being comfortably worn by the patient. These teeth, whether natural or artificial, control, to a large extent, the occlusal arrangement of the substitute being constructed. They do not necessarily restrict the labial or buccal arrangement of the case. This should be accomplished according to the requirements of facial contour and the general conformation of the arch as indicated by the temperament. If the wax rim has been correctly formed and trimmed, this will serve as a guide in the labial and buccal arrangement, while the occlusal face of the rim indicates the occlusal length of the teeth as related to the base plate.

The usual method followed in arranging the artificial teeth

on the base plate is to cut out a section of the labial face of the wax rim sufficiently broad to allow one of the central incisors to be dropped into the space thus formed (see Figs. 47-48). The tooth should be correctly placed as to length and

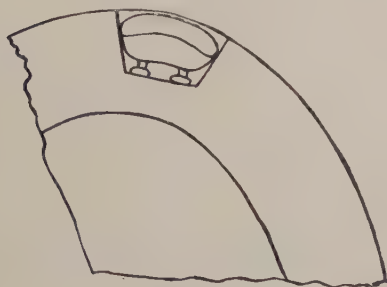


FIG. 47.



FIG. 48.

inclination, both labio-lingually and mesio-distally. If the section of the wax removed is approximately the width of the first tooth to be adjusted the approximating margins of the wax indicate its labial position. When placing the second one in position the tooth already adjusted serves as a guide



FIG. 49.

on one side, while the wax margin, as before, gives the opposite point, and so on, the tooth last placed and the margin of undisturbed wax indicating the correct position for the tooth being adjusted. In a general way the six anterior teeth are arranged in the segment of a circle, more or less regular, the

labial surfaces of the cuspids being usually slightly more prominent than the laterals, especially at their cervices.

193. From the cuspids backward the bicuspid and molars, when viewed occlusally, are arranged in almost a straight line, which, if projected backwards, would pass slightly inside the inner wall of the glenoid fossæ. In many mouths the teeth are already on a nearly true parabolic curve, as indicated in Fig. 49. The side curves are oftentimes so indefinite that



FIG. 50.

they appear to be stright lines, and in the arrangement of artificial teeth those in this location are placed accordingly.

194. Viewed buccally (Fig. 50), the bicuspid and molars should curve upward toward the glenoid fossæ, the amount of curvature depending on the depth of overbite of the upper anterior over the lower teeth. When this is quite marked or considerable the curvature should be considerable.

195. Another factor which should be taken into consideration—and will be as soon as some convenient means are provided for measuring it—is the downward inclination, or line of direction in which the condyles move when the lower jaw is projected forward. This line of direction varies in different individuals and frequently varies in the same person, one condyle dropping noticeably lower than the other. Some practical means should be provided for accurately registering this movement and an occluding frame constructed so that the slot on each hinge may be adjusted, independently of the other, to correspond with the movement of the condyle as it passes forward on the eminentia articularis. When we are provided with such appliances then, and not until then, can we hope to register mathematically correct movements and secure absolutely perfect relation of the teeth in full and partial occlusion.

196. As a rule, the teeth furnished by any and all supply

houses are incorrect as to occlusal forms or requirements. The central groove is not distinctly marked nor deep enough. The cusps are too full in their occlusal inclinations and their various planes are entirely too rounded to admit of the close-locked occlusion or contact of surfaces demanded for the proper mastication of food.

This can only be remedied by the reconstruction or substitution with others of correct form of the molds in which the teeth are formed previous to baking. As this would involve an expense of thousands of dollars, the manufacturers will make no effort to produce better teeth until pressure is brought upon them by the dental profession, or until some firm more enterprising than the others takes the initial step and will furnish teeth of correct form, when the other manufacturers will

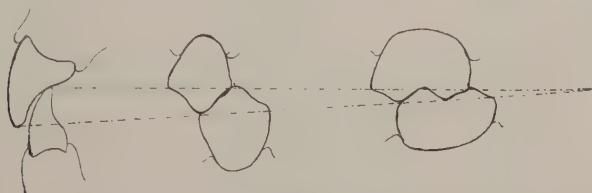


FIG. 51.

naturally be compelled to follow. It will scarcely be possible to produce teeth of absolutely correct form, which will in no way require modification by grinding, but the present product can be vastly improved.

197. In the teeth as now furnished it will be found necessary to deepen and widen the central grooves of the bicuspids and molars, not only in upper, but in lower sets as well. More grinding is, of course, required in the bicuspids than in the molars, the first bicuspid requiring the most and the second molar the least, as indicated in the diagram (Fig. 51). A deep overbite of the anterior, with shallow grooves in the posterior teeth, would result in contact in the anterior part of the mouth and none of the back part, when the teeth were in partial occlusion.

Arranging Full Upper and Lower Dentures.

198. The upper teeth should be placed in line as indicated, the wax on their lingual surfaces melted around the pins and the surplus cut away. The lower teeth should be occluded

so as to strike against the upper ones as closely as possible. Lateral movement should then be given the occluding frame and the molars and bicuspid adjusted on the "working side," or on that side which is *not* projected forward so as to come in close contact while in this position.

199. On the side on which mastication is performed the buccal cusps and marginal ridges of the lower bicuspid and molars are projected laterally outward until they are in close contact and alignment with the buccal cusps and marginal ridges of the upper bicuspid and molars.

200. On the opposite side, or that one which is projected forward, the buccal cusps of the lower second molar come in contact with the lingual cusps of the upper first molar, these two teeth usually being the only ones in contact on this side.

201. The anterior teeth come in contact, or their incisal edges cross somewhere between the central incisor and cuspid on the *working side* of the mouth.

202. All mastication is performed on that side of the jaw that is not thrown forward, and the crushing of food is accomplished as the projected condyle glides back to its position in the glenoid fossa.

When the three-point contact is secured in a general way, the relation of each individual tooth, as to its occlusion with the opposite teeth, is closely studied and a close and proper contact secured by grinding.

203. Before beginning the arrangement the deepening of the central grooves of the bicuspid and molars may be accomplished, partially at least, and the final grinding and arrangement completed when all are in position in the wax.

204. Very frequently it will be found necessary to modify the slope of the mesial or distal planes of the cusps, in order that the teeth may glide smoothly over each other in lateral movements. Again it is often necessary to reduce the mesio-distal diameter of a bicuspid or molar, at the expense of the mesial or the distal surface, or sometimes both, so that it may take its place in proper relation to the opposite teeth and thus allow the others on the same side of the jaw to occupy a like relation.

205. There is no more important subject in dentistry than the study of occlusion. To the lack of a proper understand-

ing of it may be traced many of the failures we meet with and hear of, and a great many, no doubt, occur of which we hear nothing.

The late Dr. Bonwill devoted a great many years of his life to the study of this subject, and wrote at various times upon it. His articles, which appear in the American System of Dentistry, in Essig's American Text Book of Prosthetic Dentistry and in the Items of Interest of 1899, will be well worth the time spent in their perusal. Some claims made by him on this subject at different times and in a paper read before the World's Columbian Dental Congress in 1893 are undoubtedly erroneous and without foundation; but he deserves the credit for calling the attention of the dental profession to this subject and of keeping it before them until an interest was aroused, and to-day this is becoming one of the absorbing topics in prosthetic dentistry. Dr. W. E. Walker has also written some very able articles along this line, presenting a slightly modified phase of it. These papers can be found in the Dental Cosmos in 1896-7-8.

The following series of photographs, with accompanying text, from the Dental Cosmos, January, 1901, is here given, to call attention to the general appearance of the natural teeth at various stages of life. Note that in almost every instance the high lip line is even with the cervical portion of the centrals. See paragraph 145. The text of the article referred to is given entire.

NATURE'S DENTISTRY.

Looking at Nature.

"If a close observer will examine the dental organs of a number of persons whose natural teeth are well preserved, he will find conditions which will surprise him unless he has previously been posted as to what to expect. Perhaps the first thing he will note is the quite common variation of size between the corresponding teeth on the two sides of the jaw. It is doubtful if he will anywhere find a set of natural teeth where every tooth perfectly duplicates its fellow on the other side of the mouth. Teeth which, to the casual glance, appear perfectly symmetrical will be found on close examination to vary considerably. He will be apt to find one central longer than

its fellow, or wider, or larger in both dimensions. The upper laterals are more frequently unlike each other than otherwise. Even the cuspids will vary, if not in size, then in position.

Nature's Ways.

"It is nature's way to make every tooth differ in some way from every other. The variations are so small usually that they simply tend to the production of harmonious beauty by the relief of what would otherwise be monotony. It is rare to find them so marked that they appear disfiguring. Their purpose is to individualize each tooth. If, for the purpose of the examination, subjects are selected whose ages vary from, say, twelve to sixty years, other methods of nature will become apparent. The gradual wear of the occlusal surfaces of the teeth will be plainly evident. Shortly after eruption the use of the teeth in mastication begins to wear away the delicate cusplets found on the newly erupted incisors. Then the incisal ends become rounded or convex from side to side. The wear still progresses, until by the time the age of fifty or sixty is reached the ends are squared and the edges chamfered into chisel shapes, the edges of the chisels at the labial face in the uppers, at the lingual face in the lowers. At the same time the cusps and ridges of the cuspids, bicuspid and molars are worn until the perfect occlusion is produced wherein considerable surfaces of the opposing teeth rest squarely against one another when the jaws are closed. As age advances also, the angle of the front teeth to the jaw changes. In the young the teeth are nearly or quite vertical. As time passes they are more and more inclined forward, with a tendency to the production of an end-to-end occlusion.

A Lead to Follow.

"The earnest worker in prosthetic dentistry will find in these facts valuable hints for his guidance in the construction of artificial dentures. It is of the highest importance that an artificial denture shall bear a relation to the age of the wearer, as well as to the complexion and the general physical make-up. Otherwise its artificial character is at once discovered. While it is impossible for the manufacturer to supply forms adapted to all ages, the corundum wheel will quickly make the neces-

sary changes in the porcelain teeth as purchased. A little manipulation in setting them up will cause a tooth or two to be covered more or less with the vulcanite when finished. If plain teeth are used, they are easily arranged to simulate irregularity in alignment. Other expedients which have been employed in the production of natural appearing dentures are, the placing of a dark tooth in the arch to give the appearance of a dead tooth; the placing of fillings in one or more; the mounting of a gold crown in place of one of the bicuspid.

The Patient's Right.

We now supplement these with a series of reproductions from nature, showing the natural teeth at various ages and so much of the faces of the subjects as is necessary to clearly set forth the harmony of nature's work. These make plain the accuracy of the description of nature's ways in the paragraphs quoted. An examination of these faces will bring home the right of the patient requiring an artificial denture to such service as shall fulfill the conditions prescribed in the statement which follows from the Dental Cosmos for April, 1900:

"By 'high-grade prosthetic dentistry' is meant the practical recognition by the dentist in his product of the patient's rights in an artificial denture; his right to have every function of the natural teeth restored, so far as that is possible by prosthesis. The restoration of mastication and speech is but a small part of what is involved. The patient has an undoubted right to expect that the artificial denture for which he pays shall also measurably restore the normal appearance of the lower portion of his face, and that it shall not, by incongruities in the size, shade or arrangement of the teeth declare to the beholder, as clearly as though it bore a signboard, 'These teeth are false.'"

How Nature Builds the Permanent Teeth.

Of course, it is not possible for the prosthetic dentist to follow nature's methods in providing a denture. When nature builds the permanent teeth she is also forming the jaws in which they are placed. The first teeth of the natural set to erupt are the first molars—the bases of the arches, just in the rear of the second molars of the deciduous set. The next are

the central incisors, the centers of the arches, then follow the lateral incisors, after these the bicuspid, which take the place of the temporary molars, and last of all the cuspids—the keys to the arches. The cuspids are among the most important teeth in the mouth, as is indicated by their powerful formation and by the depth to which they are implanted in the jaw. They constitute the first spring of the arch, are really the keystones, and with their long, thick roots establish the proper fullness of the face. Two other teeth, the second and third molars, are afterward added behind the bases of the arches. The teeth of the lower jaw usually precede those of the upper by a short period, thus becoming, as it were, the matrix which determines the occlusion. While all this is going on—namely, from the sixth to the eighteenth year or later—the jaws are in a formative stage.

The Prosthetic Dentist's Way.

The position of the prosthetic dentist differs. He must take conditions as he finds them. The jaws are as a rule already formed before the patient comes to him, and the occlusion is a fixed quantity. Man at least does better work when he has a fixed point to start from, if such a point is not a necessity to him. Consequently, in setting up the teeth for an artificial denture, he starts at the median line and builds backward. If both upper and lower sets are to be made, the upper precedes the lower. Conditions over which he has no control, as has been explained in a previous article, prevent his placing more than fourteen teeth in a full set, and also compel him to use teeth of a somewhat different size from their natural predecessors. There is, however, no good reason why his results should not approach those of nature in congruity of appearance. He has merely to build on the foundation which nature has made, and it behooves him to do his best to reproduce nature's effects, so as to restore harmony as far as possible.

Some of Nature's Variations.

Irregularity of alignment of the lower incisors is almost the rule in nature. Of all the examples shown, in only one, No. 2, is a really regular alignment seen. Each has its separate characteristics.

Irregularity of size or, perhaps more frequently, disagreement in the width of corresponding teeth is quite common. This characteristic does away with monotony and produces a more agreeable effect on the beholder than the sameness so frequently found in artificial dentures.

Elongate central (sometimes including the lateral) is another pleasing variation found in nature.

Perfect occlusion is not found until the teeth have become somewhat worn by abrasion. This abrasion often causes an additional closure of the jaws, sometimes sufficient to force one or more of the upper anterior teeth out of their normal alignment.

Observe, Compare, Reflect, Record.

The subjects of the illustrations we have shown were selected not for any special feature, but simply to make a series from youth to old age. Our hope is that they may contribute somewhat to the elucidation of a subject but little touched upon in the textbooks—namely, the importance of the study by the prosthetic dentist of nature's handiwork. There can be no better rule for him than that which is embodied in the motto of the Dental Cosmos—"Observe, Compare, Reflect, Record."

Observe nature's work, compare it with your own, reflect how you can improve, and record the improvement in dentures which ever approach nearer and nearer to nature's types.



FIG. 52.

A girl of eleven years. First molars fully developed, upper incisors and bicuspid and the lower right bicuspid in position, the deciduous lower right first molar still remaining. The two lower left bicuspid are erupted on the outside of this molar, and the lower cuspids have the points of their crowns through the gum. In the upper jaw, high up near the lip, the gum about the position of the left cuspid is swollen, indicating the coming of the tooth. No indication of the upper right cuspid. The upper centrals have a slight pitch toward the median line. The right lateral is slightly rotated. The lower centrals are also slightly rotated. Overbite.



FIG. 53.

A girl of fifteen years, with all the teeth in position except the third molars. The principal feature of this denture is the regularity of the alignment, that of the lower incisors and cuspids especially, which has caused a spreading apart of the upper incisors, which overbite them.

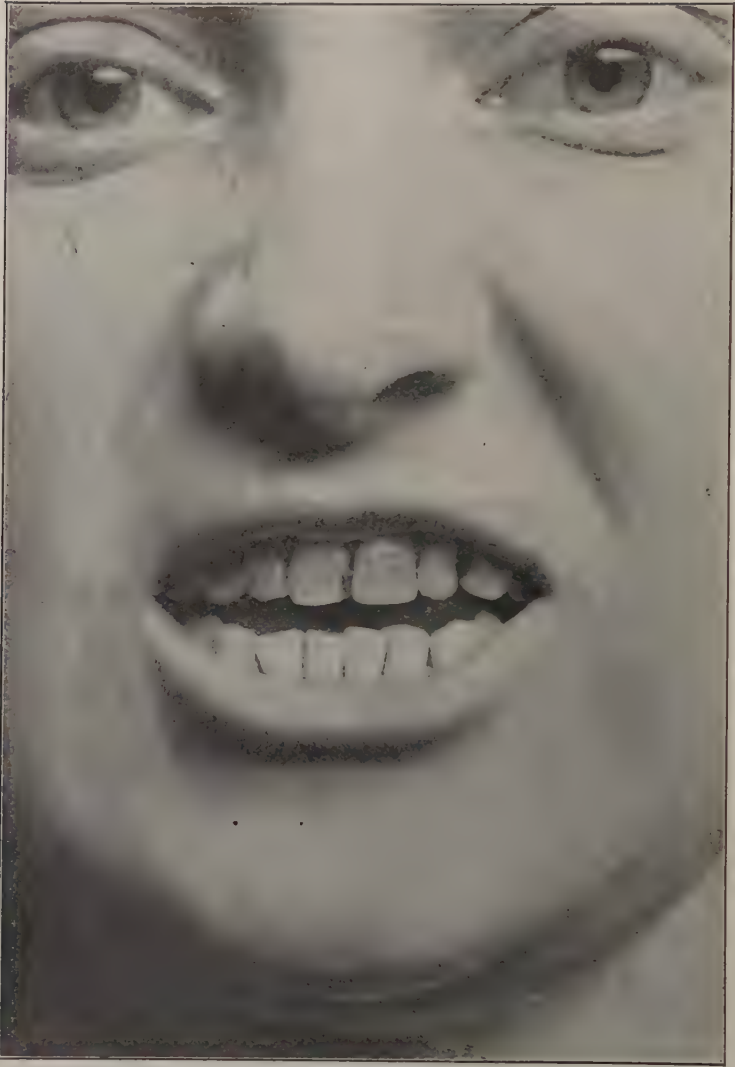


FIG. 54.

A young woman of twenty-one years. Entire set of thirty-two teeth in position. The upper centrals are nearly as wide at the necks as at the incisal ends, the left slightly overlapping the right, and the facial alignment of the teeth inclined to be flat. The laterals are slightly rotated toward the centrals, and ragged on their incisal ends from occlusion. Three fillings in the upper teeth. The lower incisors have thin incisal ends. The color of the teeth is inclined to a transparent blue.

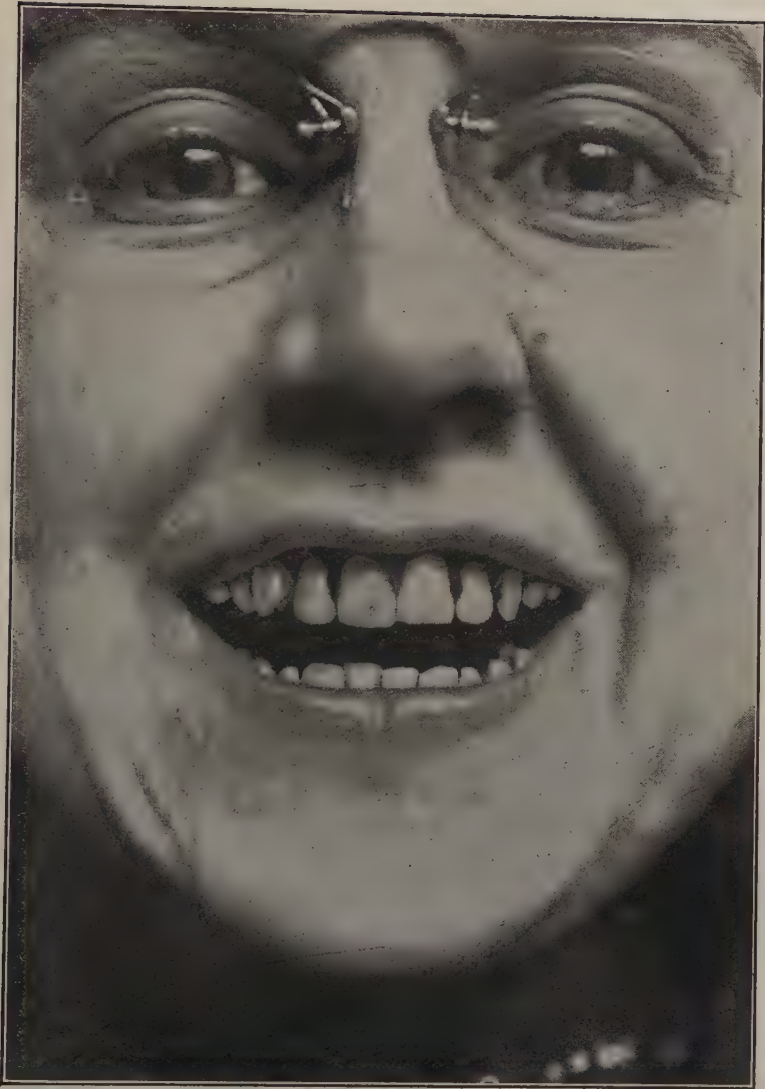


FIG. 55.

A young woman of twenty-two years. Full set of thirty-two teeth. Upper central incisors much narrower at the necks than at the cutting edges, the laterals also markedly so. Upper left cuspid in normal position; upper right cuspid forced outside by occlusion with the lower cuspid and first bicuspid, and rotated so that its anterior approximal surface is visible. The lower incisors are typically irregular. The left upper cuspid and right and left laterals have small fillings. Thin teeth. Color whitish gray.

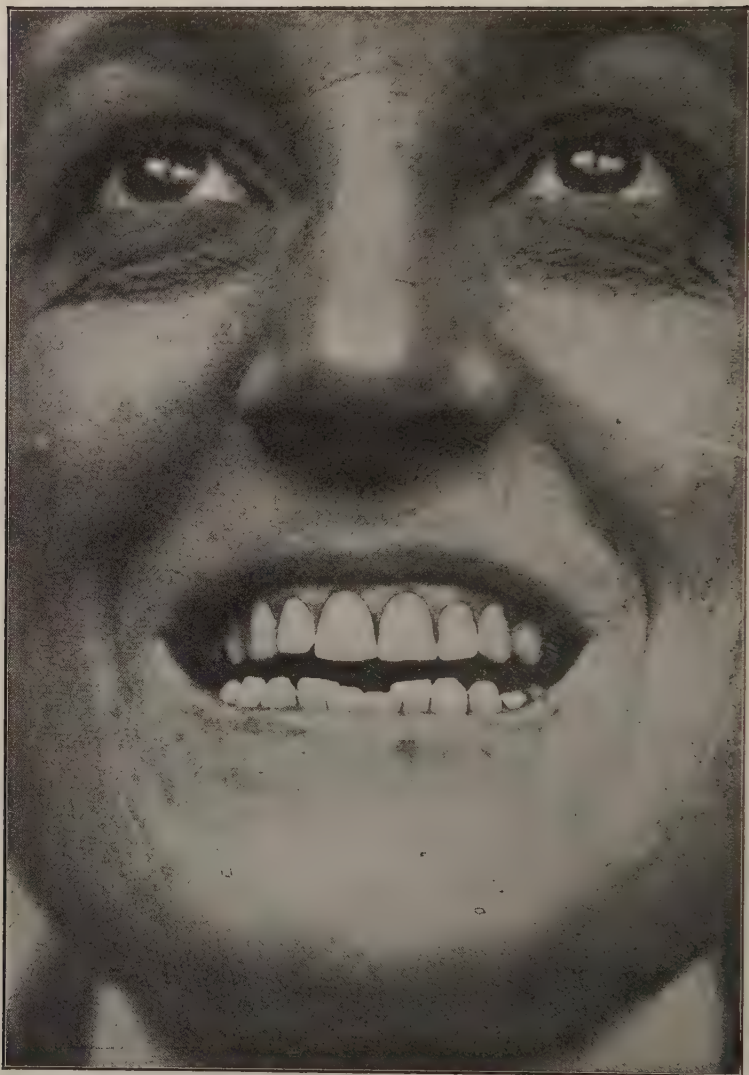


FIG. 56.

A woman of thirty-three years, nervous temperament. Slight irregularity of alignment in the upper incisors; considerably greater irregularity in the lowers. Slight difference in size between the upper centrals. Bite about one-fourth the length of the upper central crowns. Color, incisors bluish gray, cuspids considerably darker, a decided yellow. Slight evidences of the wear of mastication.

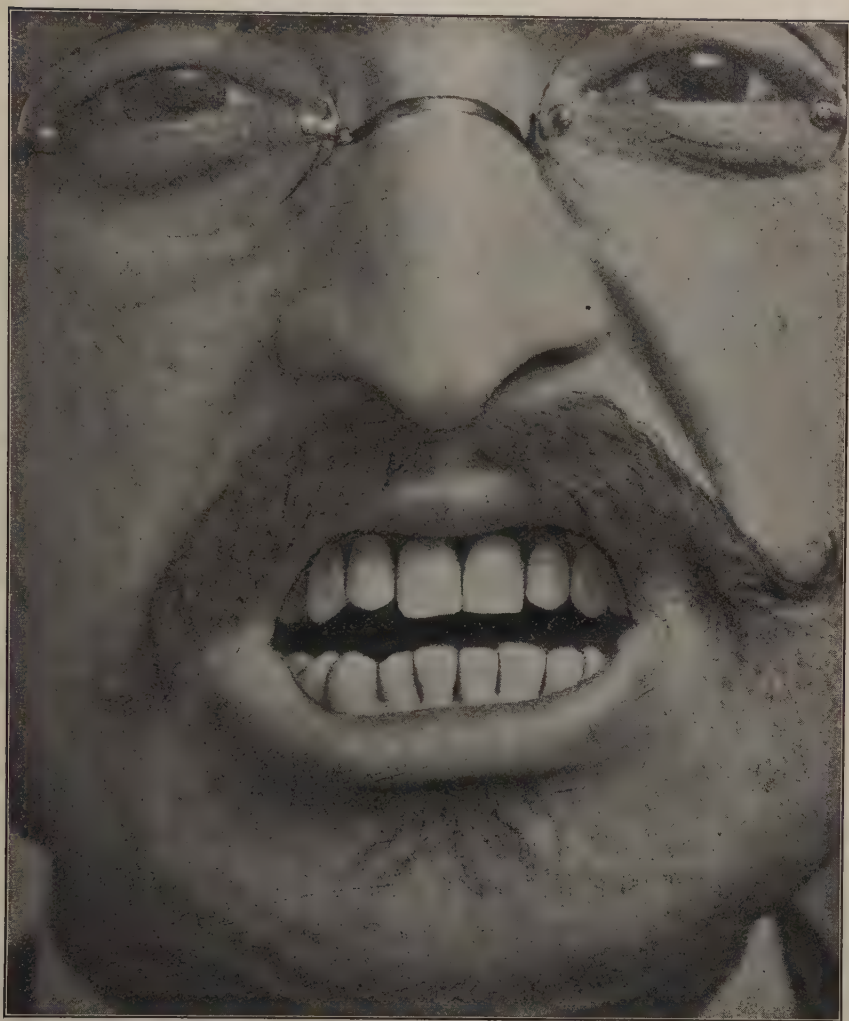


FIG. 57.

A man of thirty-four years. Full complement of teeth, except that the lower left first molar has been lost. Teeth long in proportion to width; a fine example of the elongate central. Right lateral slightly out of alignment; lower incisors handsomely irregular. Color light yellow, a trifle blue at the cutting edge.

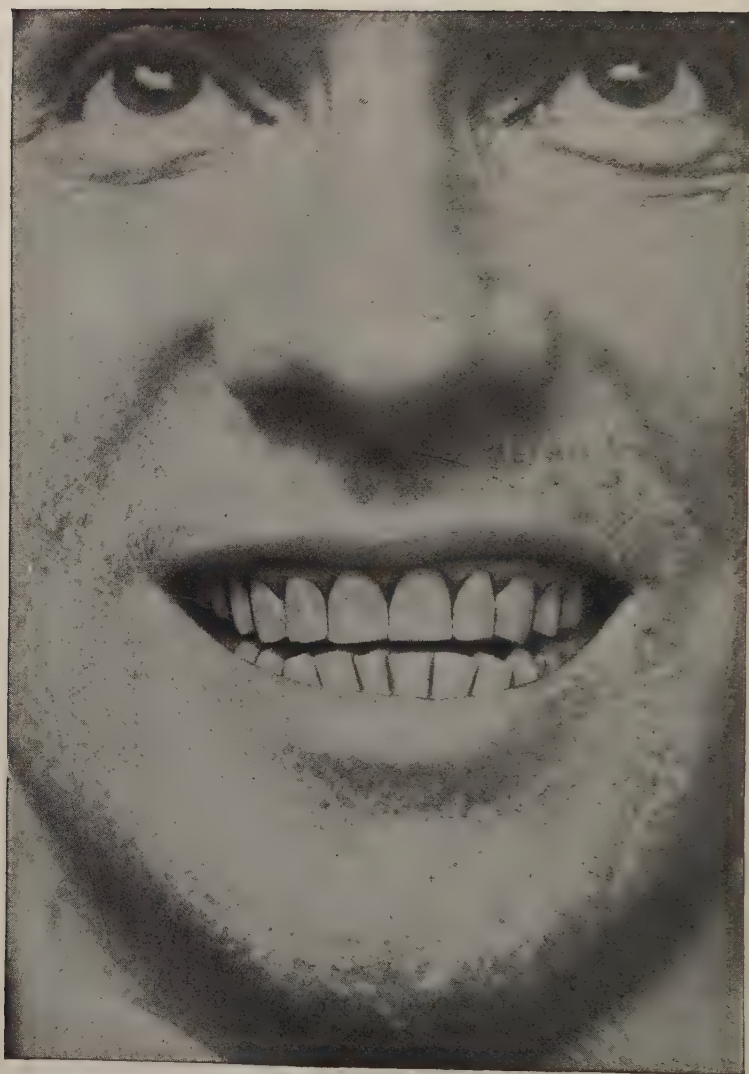


FIG. 58.

A man of thirty-five years, bilio-sanguineous temperament. Very slight irregularity in the alignment of the upper teeth; more marked in the lowers. The upper laterals are rotated, the left more than the right. The upper centrals vary in width and the left slightly overlaps the right. The upper cuspids have an inward pitch toward the median line. Bite very short, just sufficient to produce a chisel edge on the incisors. Color yellowish, with transparent blue line at incisal ends. Effects of wear very distinct, more especially where the upper cuspids interlock between the lower cuspids and first bicuspid.

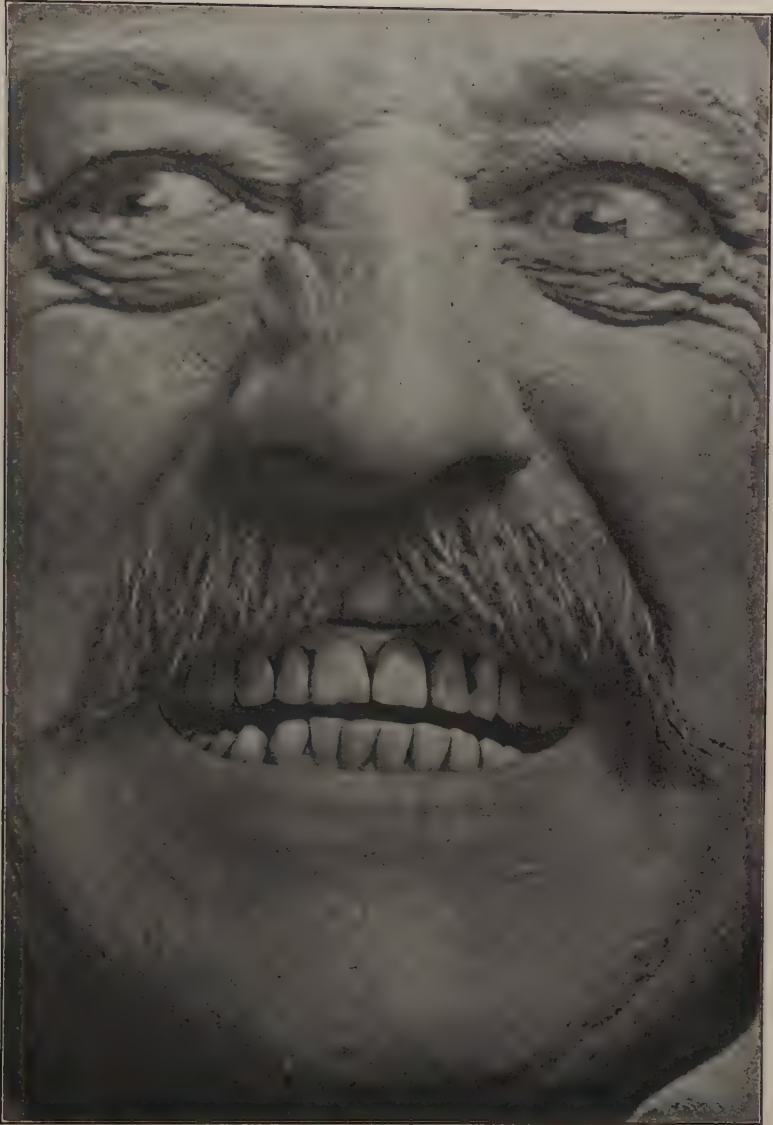


FIG. 59.

A man of forty-eight years, with full complement of teeth, all in sound condition. Upper teeth in almost perfect alignment. Lower teeth slightly irregular, the right central crowded forward and overlapping the right lateral and the tip end of the left central. The upper right central is much larger than the left, while, apparently to make up for this discrepancy, the left lateral is wider than the right. Occlusion and bite perfect, one-fourth overlap. Color of teeth, gray.

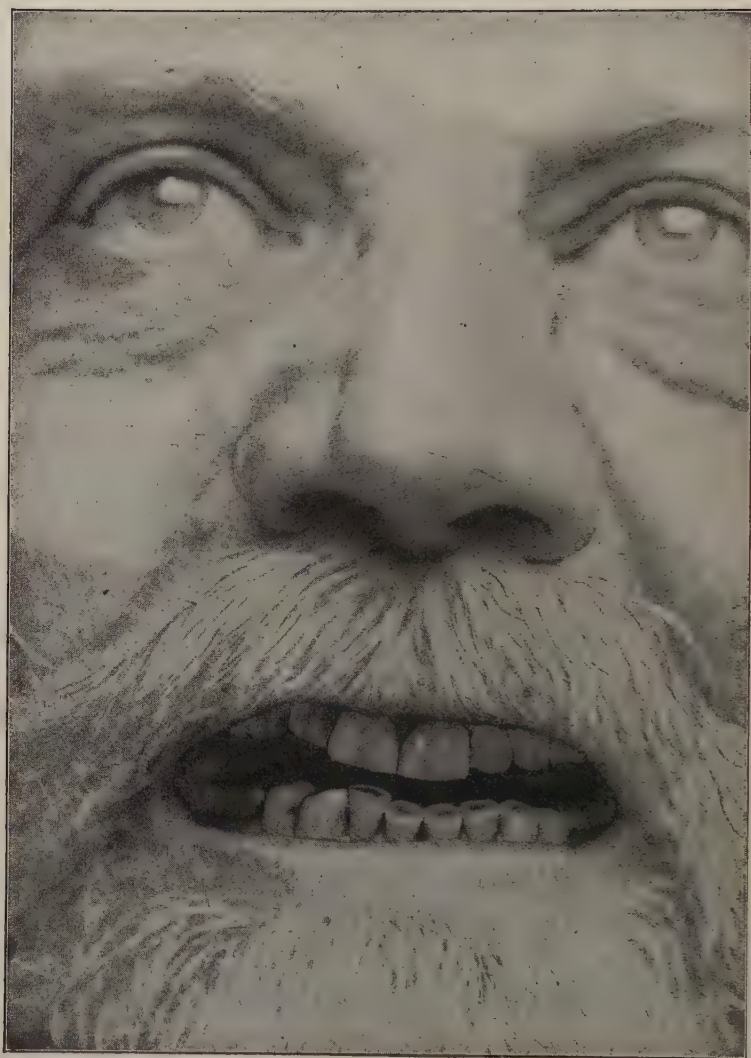


FIG. 60.

A man of fifty-nine years, an inveterate smoker. All the anterior teeth in position, but well worn by abrasion, as might be expected. Of the posterior teeth the lower right first molar, lower right second molar, and upper right second bicuspid are lost. Lower teeth abraded nearly one-half the length of the crown. The dentin where worn away shows dark stains from the tobacco. The color is a light brown, rather a pinkish shade.

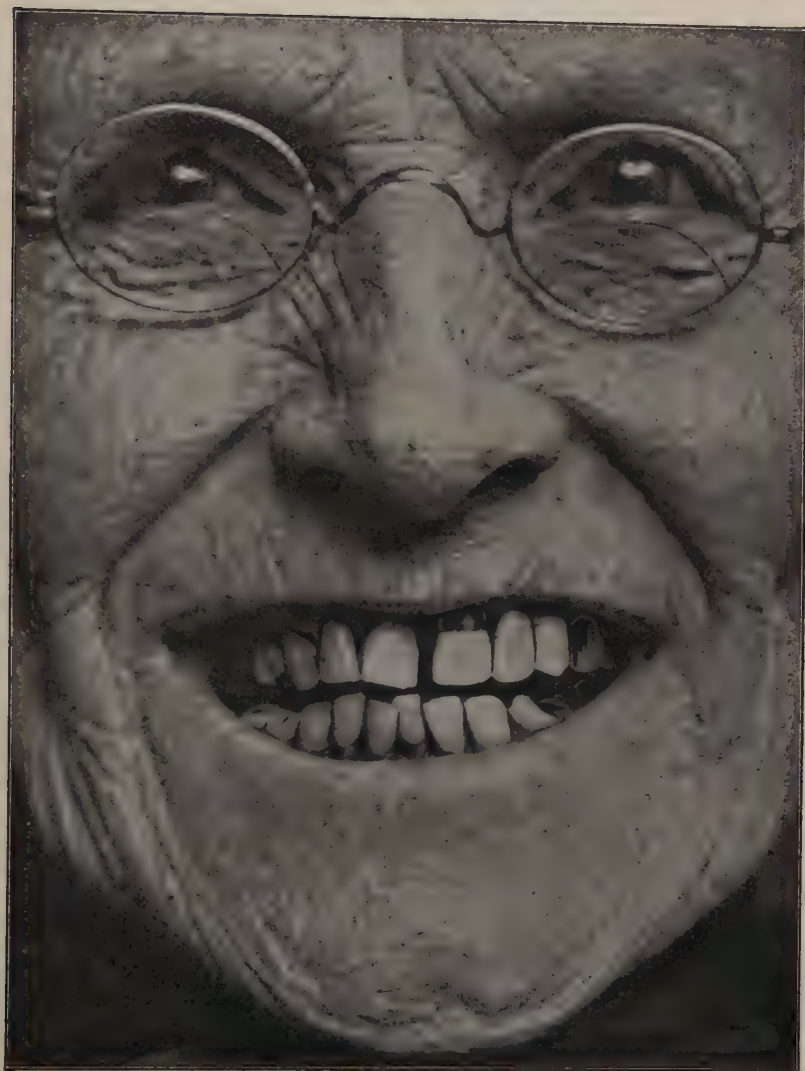


FIG. 61.

A woman of seventy-one years, mother of a large family. Still retains the lower anterior teeth, with the bicuspids, which are worn considerably, especially the left second bicuspid, the first being driven toward the median line. Absorption of the gum around the lower centrals and laterals. In the upper jaw there remain, on the right side, the central, lateral, cuspid, first bicuspid, and second molar; on the left side, a central root, a first bicuspid root, and the first and second molars. The left central (a Richmond crown), lateral, cuspid, and first bicuspid (a gold cap crown) are artificial. The space between the centrals has been enlarged by the force of occlusion, the lower natural teeth forcing the artificial ones backward and outward.

The following series of cuts of dentures which have appeared from time to time in the Dental Cosmos will materially aid the student in forming an idea of the correct arrangement and appearance of the teeth, as well as the general peripheral outlines of high-grade artificial substitutes. Oftentimes, by imitating some slight irregularity, such as throwing a tooth out of line, rotating, lapping over the proximating tooth, elongating, or possibly leaving out a bicuspid, especially when the patient's mouth presented some such feature, the artificiality of the substitute may be entirely disguised. Most of these illustrations appear in the American System of Dentistry in an article on celluloid and zylonite, by Dr. W. W. Evans.

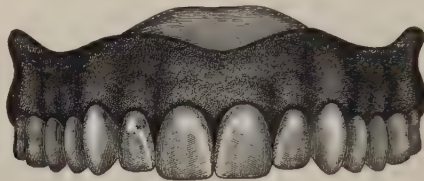


FIG. 62.

Fig. 62 represents the sanguineous temperament, as to the shape, outline and alignment of the teeth, and the general form, "well proportioned, abounding in curved or rounded outline; cusps rounding."

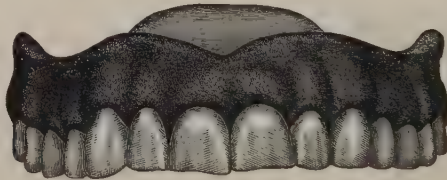


FIG. 63.

Fig. 63 is an example showing considerable wear, representing the condition of the teeth at, say, fifty years. The teeth are regular in alignment.

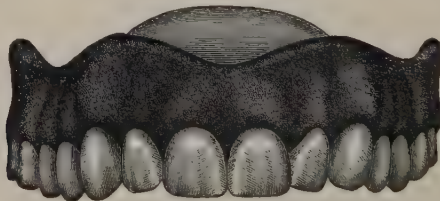


FIG. 64.

Fig. 64 shows a common alignment of the incisors, the laterals pitched slightly toward the centrals. The occlusal ends of the teeth are ground a little to show slight wear, as at the age of twenty-five or thirty years.

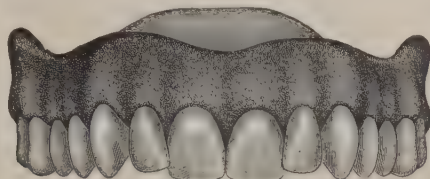


FIG. 65.

Fig. 65 shows the centrals pitched inward, the laterals overlapping and somewhat shorter. The cuspids are prominent as to length and cervical fullness.

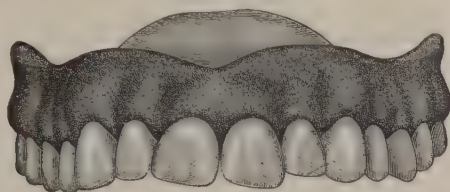


FIG. 66.

Fig. 66 shows the incisors forced out of their proper alignment by the opposing teeth, a condition quite often found after forty. The teeth are worn by use, enough in the case of the bicuspid and molars to allow the lower incisors to wedge the uppers forward as shown. In this and the two previous examples the teeth are supposed to be ground by the dentist.

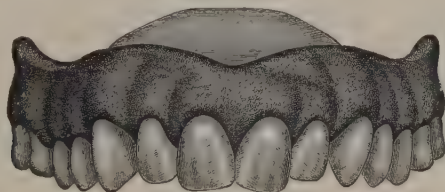


FIG. 67.

Fig. 67 shows a directly opposite condition from that seen in Fig. 69. The centrals are rotated to form a V-shaped or pointed arch, and with the laterals pitching toward the facial line; the cuspids are so placed as to narrow the arch at the point of their insertion.

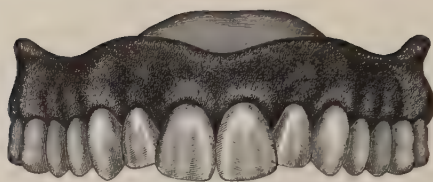


FIG. 68.

In Fig. 68 there is a strong prominence of the central incisors, with the laterals inclined forward and standing behind the centrals. The arch is somewhat contracted from the cuspids forward.

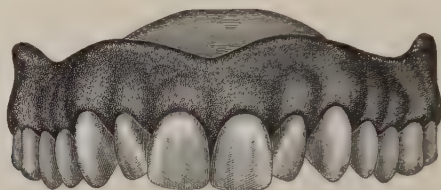


FIG. 69.

In Fig. 69 the centrals are rotated toward the median line and depressed at the incisal ends; laterals rotated to expose their anterior approximal edges, with a pitch toward the centrals.



FIG. 70.

The Miss of Twelve.

Fig. 70 represents the teeth of a miss of twelve or thirteen years. The cuspids are not yet fully erupted, and the incisors show a very marked example of the cusplets which adorn them when first erupted.

The Young Woman of Eighteen.

Fig 71 is a representation of the teeth of a young woman of sanguineous temperament, eighteen to twenty years of age.



FIG. 71.

All the teeth are fully erupted, and the little cusps of the incisors are nearly effaced. Every tooth is in a healthy condition.

The Young Man of Twenty-five.

Fig. 72 shows the teeth of a man, with preponderating nervous temperament, of twenty-five to thirty years. The teeth are fully developed, large, with a long overbite. The upper



FIG. 72.

cuspid are elongate and inclined slightly inward. The lower incisors are considerably crowded and inclined. The upper right first bicuspid and the lower left first molar have been lost. Approximal fillings are shown in the two upper centrals.

The Woman of Thirty-five.

Fig. 73 shows the teeth of a woman of thirty to thirty-five. There is a rather long overbite, and the chamfering of the

edges of the lower incisors is plainly seen. The right central overlaps the left. Two teeth are lost from these arches, the right upper first bicuspid, and the left lower first molar. The

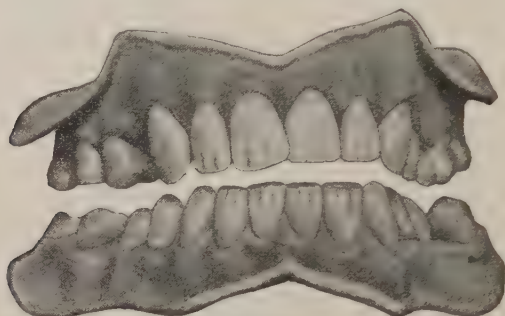


FIG. 73.

upper plate is provided with plumpers to restore the contour of the cheeks.

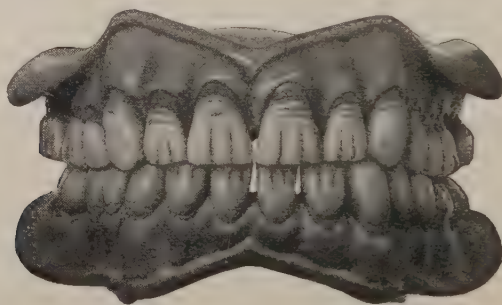


FIG. 74.

The Man from Forty to Fifty.

Fig. 74 represents the teeth of a man of from forty to fifty. Occlusion almost end to end. Some recession of the gum. Plumpers to restore the cheeks to proper fullness

The Elderly Man.

Fig. 75 shows the denture of a man over fifty years of age. The front teeth are inclined well forward, with end-to-end occlusion. The effect of wear is seen on the incising edges of the lower incisors and indicated by the squaring of those of the upper. Lower incisors separated, as is often seen in nature. Gums considerably receded.

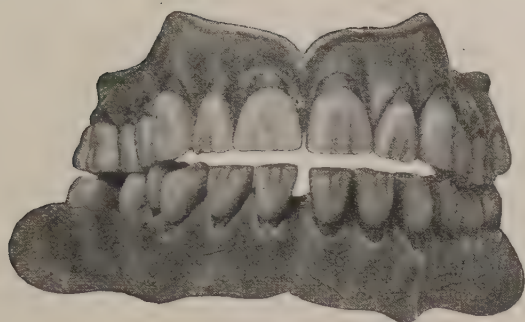


FIG. 75.



FIG. 76.

Teeth arranged irregularly in the arch.



FIG. 77.

Middle age, showing moderate wear of teeth.



FIG. 78.

Age. Teeth showing wear from use.



FIG. 79.

Age. Teeth showing wear from use, and loss of the first left superior bicuspid.



FIG. 80.

Fig. 80 shows a full upper and lower denture suitable for a person under thirty years of age. The cusps are prominent and the incisal edges show but little wear. The right lateral is slightly irregular and overlaps the central incisor.



FIG. 81.

Fig. 81 represents a set of teeth suitable for a man between fifty and sixty years of age. It is a "square bite" and shows slight abrasion of the incisal edges. There is also some slight recession of the gums, more noticeable in the lower incisors and cuspids than in the upper. Prominent cuspid eminences. The arrangement and form of the teeth indicate a nervous temperament.

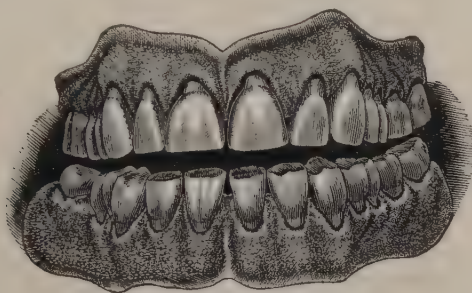


FIG. 82.

Age, showing wear from use, and the retraction of the gum.

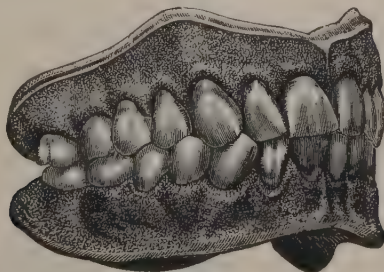


FIG. 83.

Teeth arranged irregularly in the arch.

CHAPTER IX.

Waxing, Flasking and Packing Cases.

206. The teeth, having been properly occluded and their arrangement perfected, the next step will be to carve, in wax, a representation of the natural gums and complete the waxing on the lingual portion of the case. The wax should be melted around the lingual surfaces of the teeth so that the pins may be perfectly inclosed in it, and when cold the teeth will be sustained in their proper position. A strip of wax about 2 mm. wide should now be carried entirely around the buccal and labial portions of the case, allowing it to rest on or cover the cervices of the teeth. Another strip is carried

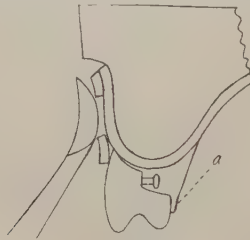


FIG. 84.

around the peripheral termination of the case, also on the buccal and labial surfaces. The large, round end of the burnisher is thoroughly warmed, but not heated sufficiently to melt the wax, and the margins of the strips nearest each other burnished against the base plate. (See Fig. 84.)

207. The terminal margin of the base plate should be somewhat thick and rounded, while that portion over the cervices of the teeth should be from one to one and a half mm. thick. This is necessary in order that in the final finishing and polishing of the case there may be enough material present to permit of this being properly done. The cuspid ridge should be developed as prominently as the case demands, and

usually this can be quite plainly marked. The pointed end of the spatula is warmed and the wax forced into the interproximate spaces, being careful to fill them up quite full (Fig 85). The sharp point is now used as a knife blade and the proper curvature given to the wax over the cervical ends of the teeth (Fig. 86). The wax should not cover very much



FIG. 85.

of the porcelain, for if teeth of correct form and length have been selected, and a considerable portion is covered, more difficulty will be met with in trimming away the vulcanite than if just the correct amount of wax was applied. If the wax is too bulky and the vulcanite is not removed to the proper extent the outline forms of the teeth will be modified.

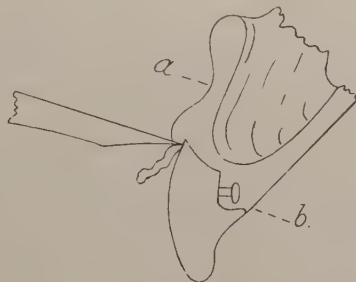


FIG. 86.

208. The wax in the interproximate spaces should be removed enough to give the proper curvature in the gingival line of each tooth. If these spaces are cut out deeply they invite the lodgment of food in the finished denture, a condition decidedly objectionable. The gingival termination of wax should be almost at right angles to the face of the porcelain (Fig. 86).

This angle is rounded down with scrapers and by the polishing wheels on the lathe.

209. As a rule, the gum restoration should present a concave surface from gingival line to peripheral termination of the plate (Fig. 86a). This is an absolute necessity, but in most cases, when so formed, a more natural appearance can be given the case than when this surface is convex. In persons of a lymphatic temperament, the reverse of this, a convex form, is indicated. The wax on the lingual surfaces of the bicuspid and molars should be carried up to a point about half way between the shoulder of the pin seat and their occlusal surfaces, forming a slight shoulder, as indicated in Fig. 52a. This insures ample material in this location for properly finishing the case.

210. When marked irregularity in the palatine surface exists the wax should be distributed in a uniform layer over it,

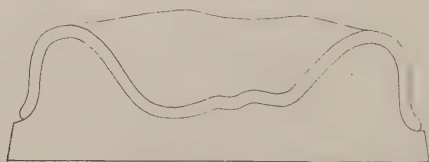


FIG. 87.

not with the idea of producing a palatine surface to the plate that is free from irregularities, but rather one in which the natural irregularities, unless very small and abrupt, will, in a general way, be reproduced. (See Fig. 87.)

The conception of what the finished denture should look like should be formed while working in the wax, and this conception developed at this time, allowing only surplus enough to insure a sufficient amount of material with which to finish.

211. The Bunsen flame should not be used for smoothing down a carved surface of wax, for, regardless of how carefully the carving may have been accomplished, it will most certainly be destroyed when subjected to the flame. The idea in waxing is to block out, in a general way, very much as a sculptor outlines his work, the form of the gums and plate, and put on the finishing touches when dressing down the vulcanite. Very artistic and pleasing results can be attained if one has a good conception of the forms of the natural gums,

and can properly manipulate the waxing spatula. Without these two requisites the most labored efforts will accomplish but crude results. The first of these requirements can be mastered by a close study of mouths and models taken from typical arches; the second condition fulfilled only by patient, persistent effort to acquire the technic of working wax.

Waxing Partial Cases.

212. These cases vary but little from the class just mentioned. Where gum restoration is to be made care should be



FIG. 88.

taken to make the line of junction of artificial gum with the natural tissues as smooth and continuous as possible, not as indicated by the dotted line (Fig. 88). Since this condition can be brought about by the proper construction of the base plate, the waxing of this should be carefully attended to.



FIG. 89.

213. On the lingual surfaces of the natural bicusps and molars the wax should be carried up to a depth of one and one-half or two mm. to insure stability in the denture by the bearing thus afforded (Fig. 89).

214. In lower cases, where the anterior teeth are present,

the wax should extend up over the cingulum or cover about two-thirds of the lingual surfaces of these teeth (Fig. 90). Finished dentures, constructed so as to have a broad bearing at this point, will not cause irritation of the soft tissue along the free margin of the gum, as is often the case when the denture is unsupported by the teeth in this location.

The wax should also be thick enough where it passes across

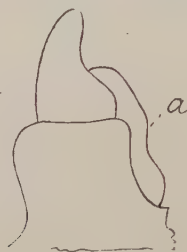


FIG. 90.

the lingual surfaces of the anterior teeth and tissues to insure ample bulk of vulcanite for strength. This is the weak point in dentures of this class (90a).

215. When the bicusps and molars are to be replaced the lingual surface of the wax in this location should be somewhat concave, so as not to interfere with the movement of the tongue (see Fig. 91).



FIG. 91.

216. When the anterior teeth are to be replaced the wax should not extend over nor cover the lingual shoulder of porcelain. The vulcanite should be finished *against* the porcelain at this point, not *over* it (Fig. 86b). In this as in all other classes of prosthetic procedures, a careful study of the requirements of the case will enable one to carry out the steps as outlined, as well as meet the contingencies of varying conditions.

Flasks.

217. When the waxing has been completed the case is ready for flasking. Flasks of various forms and sizes, intended for different classes of work, are used in the prosthetic laboratory. A flask intended for vulcanite work usually consists of a metal box, the outline form of which, in a general way, resembles the shape of a full upper denture, but is, of course, considerably larger peripherally as well as in depth.

It is made in from three to five sections, the sides consisting

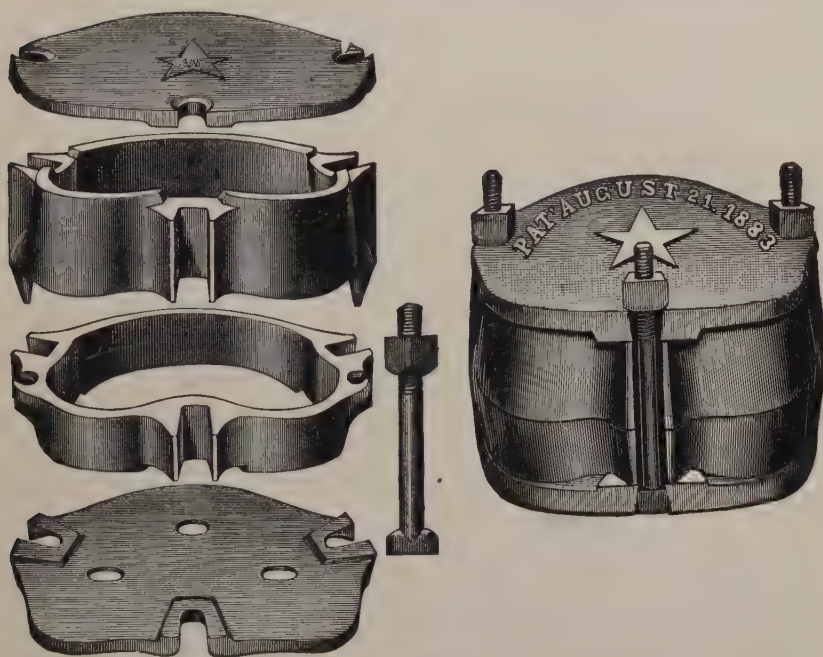


FIG. 92.

of two or three pieces, usually two, which fit upon each other and are held in position by interlocking projections, while a top and bottom, one of which always, and the other sometimes, is separable, cover the two ends and complete the flask. Three bolts, extending from top to bottom, are commonly used to hold the flask together after being packed with rubber and compressed until all parts are in contact (see Fig. 92-93).

Fig. 93 illustrates a flask for receiving cases too large for an ordinary sized flask.

Flasking Full Cases.

218. This is usually a very simple operation. The model is removed from the occluding frame and trimmed around its periphery, if necessary, to permit of its ready introduction into the flask, while its base is reduced by trimming so as to bring the terminal margin of wax on a horizontal plane with the line of separation of the two parts of the flask (see Fig. 94).

219. Another important point that cannot be overlooked is the height the teeth project upward from the line of separation. This must be less than the width of the upper part of the flask. If greater, the top of this portion will not go to



FIG. 93.

place. Trimming the base of the model overcomes this difficulty.

220. The model, after fitting in the flask, is removed and placed in water for a moment or two. The plaster is mixed and introduced in the lower part of the flask, filling slightly in excess of what is needed to surround the model. The model is removed from the water, the surplus shaken off and then pressed into the plaster in the flask to proper position, being careful to center it evenly. With a knife blade or the point of the plaster spatula the surplus plaster is carried to the margin of the wax around the entire periphery of the case, and from this line uniformly smoothed to the inner margin of the line of separation of flask.

221. The plaster in this part of the flask must not cover the wax at any point, the idea being to form the entire matrix in which the rubber will be packed in the second portion. The object of forming the matrix thus is to prevent the escape of any of the basic rubber through the pink, which forms the gums. If any should find an outlet when the case is flaked in this manner it will be at the extreme margin, and not in the body of the gums, as will most certainly occur if the line of separation is at any other point than that indicated.

The plaster having been properly smoothed and allowed to set, its surface is covered with a film of some separating medium, the second part of the flask placed in position, another mix of plaster of medium consistency made and introduced

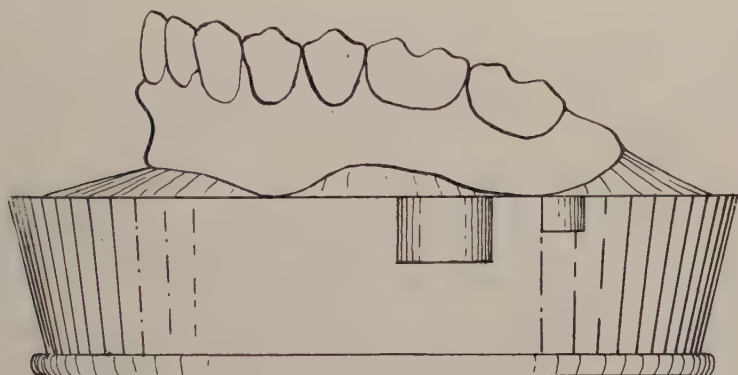


FIG. 94.

into the flask on the occlusal and incisal ends of the teeth, a little at a time, at the same time shaking the flask over the edge of the bench to settle the plaster into the deeper parts and thus exclude all air. More is added and the process continued until the flask contains a slight excess, when the top is placed on and forced into proper position. When the plaster has set the surplus is trimmed away and the flask washed clean with a brush and water to prevent soiling the hands while packing.

222. The case should now be heated to about 120 or 130 degrees F. to soften the wax, a sharp-pointed instrument forced into the line of separation and the two parts of the flask gently pried apart. As much wax as possible should be re-

moved while it is soft, the flask then set at an inclination in the sink, and a small stream of boiling hot water allowed to fall into the matrix and around the pins to remove the remaining small portions of wax. Should any wax be present in that portion of the flask containing the model it should be removed in the same manner. *All wax must be removed from matrix and model, because its presence in contact with rubber during vulcanization deteriorates the quality of the latter.*

223. Should the case have been overheated before separating, and the wax melted, boiling water is first used to remove as much of it as possible, and after removing the water a pellet of cotton, saturated with chloroform, held in a suitable pair of pliers, is passed around the matrix to remove as much of the remaining wax as possible.

Chloroform, being a solvent of wax, will partially clean it, as well perhaps as any other agent. The condition mentioned, however, is the result of carelessness in heating, and should not occur.

224. If any of the teeth have become loosened they may be cemented in their respective matrices by covering that portion in contact with the plaster with a film of liquid silicic acid and pressing into place.

All delicate or weak margins of the matrix should be trimmed away at this time to prevent their breaking and mixing with the rubber when the flask is closed. Gates for the escape of the surplus rubber should be cut *always at the back part of the flask, never on the sides*, and usually in that part of the flask containing the model, to obviate the escape of basic material through the pink gum. They should be cut in such manner as not to weaken this in any way. Frequently the gates may be cut in the plaster that forms the matrix without danger of fracture occurring.

The matrix and model should now be freed from all debris by brushing or washing, if necessary, after which the case is ready for packing.

Flasking Partial Cases.

225. These are carried forward in much the same manner as are full cases. Some of the common variations from the methods laid down will, however, be mentioned.

When plain teeth without gums have been ground to the model they are, as a rule, allowed to remain in position on the model, the plaster in the first part of the flask being carried up over the incisal or occlusal ends of the teeth in such a manner as to support them under the stress of closure (Fig. 95a.)

226. When teeth requiring gums are fitted to one side of a model and plain teeth occupy a position on the opposite side the base of the model on this side may be beveled somewhat so as to set deeper in the flask, thus giving added strength, with less bulk, to the plaster which supports the teeth at this point.

As far as practicable the line of separation of the two parts

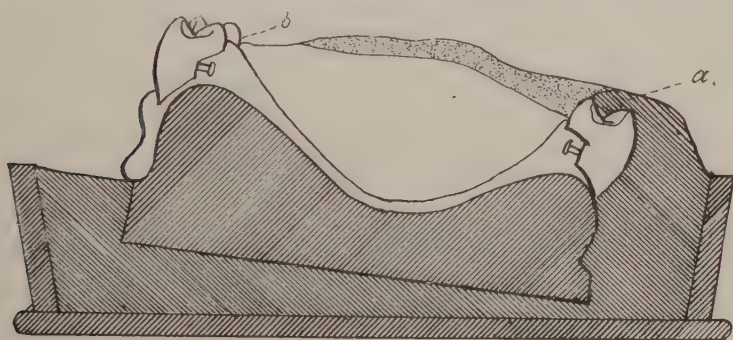


FIG. 95.

of the flask in partial cases with gums should be at the extreme margin of wax as in full cases (Fig. 95b.)

227. Projecting plaster teeth should be trimmed to the lingual margin of wax, and the model on its outer side backed up with plaster built up in convex form, extending from this point to the inner margin of the flask at its line of separation (Fig. 96).

228. The idea involved in flasking any case is to support the model so as to prevent its change of form under pressure by breakage, to construct a perfect matrix in which to mold the basic material, capable of withstanding the stress of closure and to so shape the first part of the investment that the second shall readily separate from it without producing fracture. Naturally, the form of the second investment is de-

pendent upon the first, so care should be taken to carry out this step correctly.

229. When the pins or projections, which hold the two parts of the flask in proper relation to each other, have become so worn as to allow even a slight shifting to occur, the flask is unfit for general use, in all cases where the teeth re-

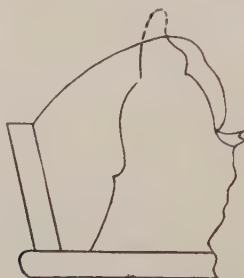


FIG. 96.

main in the upper portion and the model in the lower part. The reason is that, in closing the packed flask a change of relation in the position of the teeth to the model frequently occurs, thus modifying the occlusion, in which event a reconstruction of the case is necessary.

Packing the Case.

230. After removing all wax and debris from the matrix, or first half of the flask, it is placed over a Bunsen flame in such manner as to heat it up gradually in all parts. This step should not be carried forward too rapidly, especially in solid bottomed flasks, or a small explosion will occur. This is owing to the rapidity with which the steam next to the bottom of the flask is generated and of its inability to escape as quickly as formed. When this occurs the plaster contents of the flask will be expelled with such force as to destroy it and render it unfit for further use.

231. The object in heating the flask is to facilitate the packing of the rubber. Most rubber, while plastic at ordinary temperature, is not sufficiently so to unite readily when assembled in small pieces, as it must necessarily be in packing into the irregular matrix. The plan of heating the rubber on a slab over boiling water is suggested and followed by

many, but heating the matrix is to be preferred for the reason that as soon as the cold rubber comes in contact with the heated plaster it becomes quite soft and sufficiently plastic for packing. If the rubber is heated and packed in a cold matrix it immediately becomes chilled and is in but slightly better condition than if not heated.

232. While the flask is being heated the basic and pink rubber may be cut and prepared for use. A number of strips of pink about three mm. wide should be cut across the end of a sheet and allowed to fall upon a clean sheet of paper without coming in contact with each other. Two or three of these strips should again be cut into triangular-shaped pieces, as indicated in Fig. 97. In full upper or lower cases about 28 to 40 of these triangular pieces will be required. Three or four strips of the basic rubber are then cut and laid to one side until the pink is packed in place. As nearly as practicable, the proper amount of rubber should be cut before

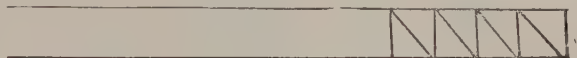


FIG. 97.

beginning to pack, in order that this step may be carried forward as rapidly as possible while the matrix is hot.

Packing.

233. The heated portion of the flask is removed from the burner and placed conveniently on the bench. A delicate pair of tweezers and a small, blunt-pointed burnisher are the principal instruments required in packing a case. With the tweezers a triangular piece of pink rubber is carried to place in one of the embrasures, and the burnisher is used to press it into the space between and back of the teeth. A sufficient number of pieces should be added to entirely fill these deeper portions, even with the ridge lap of each tooth, extending them from the bottom of the matrix up to a short distance above the cervical line (Fig. 98a). Care should be taken to work the pink into each embrasure at the extreme base of the matrix so that none of the basic material may find its way into that space, as it will be visible when the case is polished. Strips of pink are now carried around the inner wall of the matrix just above the pins of the teeth.

These strips should be pressed against the pink already in position and made to adhere to it (see 98b).

Enough of the pink in strip form should be added, the margin of one piece overlapping that of the next, to make a solid lining of pink gum extending from line of pins to the extreme top margin of the matrix and from one tuberosity around to the opposite.

234. The large, round end of the waxing spatula should be warmed and all wax removed by wiping it clean. With this rounded end pressure is brought against the various strips to condense them into a solid homogeneous mass entirely free from spaces. This plan, if properly carried out, will prevent the mixing of the basic rubber with the gum portion.

The strips of red or black rubber are now carried one at

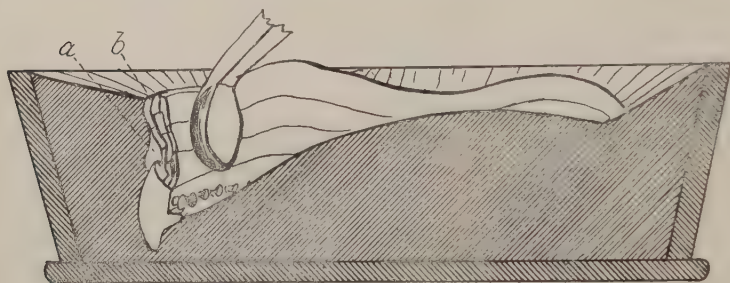


FIG. 98.

a time, in position under and around the pins, and the deepest part of the angle formed by the junction of the lingual part of the matrix with the gum portion filled in this manner.

235. A single piece of rubber is now cut and laid in to form the palatine portion of the plate. It should be broad enough to cover this part of the matrix, extending down and joining the strips already packed around the pins. A convenient way of shaping this piece of rubber to the exact size required is by cutting a pattern from the cloth which protects the sheet rubber, and shaping it so as to reach over the margins of basic rubber already in place. This pattern of cloth is then pressed against a sheet of rubber and a piece of the same size cut out, the cloth removed, and it is then pressed into position. Usually a second piece, ten to fifteen mm. wide, is added to the rubber in the palatine portion to insure

some slight excess so that the matrix may be entirely filled. A large amount of excess should be avoided because of the difficulty met with in forcing it out when closing the flask, and of the danger of distortion of the model or matrix under the extreme pressure of closing.

236. The model is now covered with a film of liquid silex and allowed to dry for a few moments. This is to give a glazed and uniform surface against which the vulcanite may be molded.

The parts of the flask are then placed in position, being



FIG. 99.

careful to fit the model against the rubber in the matrix so as not to disturb the pink nor draw it away from the sides of the matrix. The bolts are then introduced, the nuts tightened slightly, the case placed in a vessel of boiling water and allowed to remain there four or five minutes until thoroughly heated through. It is then removed and placed in the flask press (see Fig. 99) and gradually tightened until the two parts of the flask are in absolute contact. The bolts are then tightened and the case removed, when it is ready for vulcanization.

CHAPTER X.

Vulcanization.

237. The process by which rubber is changed from the plastic state, in which it is prepared for dental purposes, to a hardened condition, capable of retaining its molded form and of resisting stress, is called vulcanization. This change is brought about by subjecting the rubber to a high temperature, in the presence of steam or under water, and to the exclusion of air or oxygen. Rubber may be hardened in other media, but it is found that the best results are obtained in the presence of steam. In order to understand the changes that take place during this process it will be necessary to examine into the chemical constituents of rubber, as well as the substances which are mixed with it.

Caoutchouc.

238. Pure rubber (caoutchouc) is an elastic, gummy substance, obtained by the natural evaporation of the volatile constituents of the sap of various trees which grow in tropical countries. A few of the most common trees that produce it are the *Siphonica Elastica*, *Siphonica Cachuchu*, *Jatropha Elastica* and the *Ficus Elastica*. The trees which produce rubber thrive inside of a belt reaching about five hundred miles on either side of the equator and in any of the tropical countries of the globe.

The juice, which is white and milky in appearance when fresh, is obtained by tapping the tree and collecting it as it exudes from the incision. On exposure to air and sunlight it changes from the milky appearance to a brown or even black color, while it becomes reduced in bulk and correspondingly thickened. As the volatile constituents evaporate it becomes elastic, and when extended readily resumes its original shape.

Chemical Process Involved in Vulcanization.

239. There is no known process by which pure rubber itself may be rendered permanently hard, so in order to bring about this condition it is mixed with about one-half its weight of sulphur and subjected to a temperature of 300 to 320 degrees for a varying length of time.

Pure rubber consists of C_4H_6 (Payen), and is, therefore, classed among the hydrocarbons.

A number of theories have been advanced by different writers on this subject as to what chemical changes take place during the process of vulcanization.

240. Professors Silliman and Chandler believe that there is a direct mechanical combination of the sulphur with the rubber, a melting together of the two with a close and intimate arrangement of the molecules of each, with but little, if any, actual chemical change occurring.

241. Another theory, and one which is very likely correct, is that the sulphur, being intimately, mechanically mixed by rolling and kneading in the caoutchouc, under the influence of the steam at high temperature, chemically unites with some of the hydrogen in the gum. The product thus formed is hydrogen sulphide gas, which is readily detected by its odor upon opening the vulcanizer. The rubber, having yielded up some of its hydrogen to the sulphur, contains a larger percentage of carbon than before this change occurred, and when cold assumes a hardened, solid condition, possessing the qualities required for dentures.

242. With a smaller percentage of sulphur present, and by subjecting it to the action of the heat, it is rendered soft, yet quite elastic. This form of rubber is used for the construction of artificial vela. In addition to the incorporation of sulphur with the caoutchouc, coloring pigments are also added to improve its appearance. The pure gum, with sulphur, when vulcanized, presents rather a dirty-brown color, and while perhaps the strongest, is objectionable on account of its appearance.

243. We refer to a table given by Dr. Wildman, where the approximate proportions of the various rubbers are given. This, of course, does not include all of the colors nor for-

mulæ of rubber on the market, but it shows in a general way the proportions of the most common shades:

Dark Brown.		Grayish White.	
Caoutchouc	48 parts	Caoutchouc	48 parts
Sulphur	24 parts	Sulphur	24 parts
		White oxide of zinc..	96 parts
Black.		Red.	
Caoutchouc	48 parts	Caoutchouc	48 parts
Sulphur	24 parts	Sulphur	24 parts
Ivory or drop black..	22 parts	Vermilion	36 parts
Jet Black.		Dark Pink.	
Caoutchouc	48 parts	Caoutchouc	48 parts
Sulphur	24 parts	Sulphur	24 parts
Ivory or drop black..	48 parts	White oxide of zinc..	30 parts
		Vermilion	10 parts

244. By varying the proportions of the white oxide of zinc and vermilion in the pink, various shades of gum colors may be produced, but, as stated in a previous chapter, up to the present time there is no pink rubber made that approximates in color and translucency the natural gum tissues. Pink vulcanite is not so elastic and is much more brittle than red or black, and should, under no circumstances, surround the pins of the teeth or be used for base plate purposes.

Vulcanizers.

245. The apparatus in which the flasks, containing the packed rubber, are placed while hardening is called a vulcanizer. It consists of a boiler usually large enough to hold two or three flasks, and is commonly made of hammered copper, the sides of which are about three mm. thick. The top margin is turned true and polished, to which a cap or cover is fitted. The cover is provided with a packing of graphite or some material that will insure a tight joint and prevent the escape of steam during vulcanization. Various methods are used for fastening the top to the boiler, the most common of which is by screwing it over the margin or by some clamp device actuated by a screw, as in the case of the cross-bar appliances. (See Fig. 100.)

246. To the cover is attached either a thermometer or a steam gauge, or both, for registering the temperature or

pressure within the boiler; also a blow-off valve for emptying the boiler of steam. There should also be a safety valve attached for relieving the pressure within the appliance should it become overheated.

247. Cases in which vulcanizers have exploded, are not rare, by any means. Such accidents are always dangerous, and extreme caution should be observed to obviate them. They are usually the result of carelessness, or may be due to failure of the thermometer or steam gauge to register the pressure

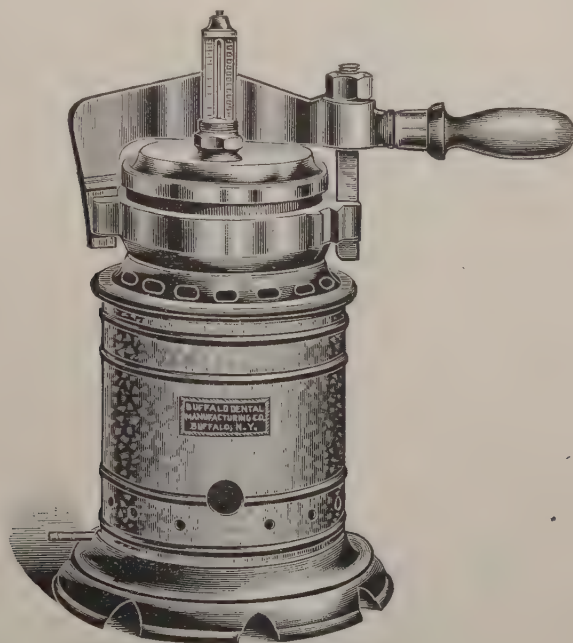


FIG. 100.

within the boiler correctly and are directly due to over-heating the apparatus. Great care should be exercised to keep this part of the appliance in good condition, in order to avoid accidents. As a rule, steam gauges are much more reliable than thermometers, and are less liable to injury while setting or replacing the top.

248. Thermometers register the temperature, while steam gauges indicate the pressure. The following table, taken from a series of experiments conducted by the French

Academy and prepared by the late Prof. Wildman, indicates the relation between pressure and temperature:

Temperature, Degrees.	Pressure per square inch, Pounds.
212	14.7
233.96	22.05
250.52	29.4
263.84	36.75
275.18	44.1
285.08	51.45
293.72	58.8
300.28	66.15
307.05	73.5
314.24	80.85
320.36	88.2
326.26	95.55
331.70	102.9
336.86	110.85
341.78	117.6
350.78	132.3
358.88	147
366.85	161.7
374.00	176.4
380.66	191.1
386.94	205.8
392.86	220.5
398.48	235.2
403.82	249.9
408.92	264.6
413.78	279.3
418.46	294

249. It is a noticeable fact that the ratio of pressure or elastic force of steam is much greater than is that of the increase of temperature. The following table, arranged in steps of practically 50 degrees, illustrates this point:

Increase of temperature.	Inc. of force per sq. inch.	Force per sq. inch.
From 212 to 263.84=51.84°	22.05	36.75
From 263.84 to 314.24=50.40°	44.10	80.85
From 314.24 to 366.85=52.61°	80.85	161.85
From 366.85 to 418.46=51.61°	132.15	294.00

As a consequence, vulcanizers should be arranged with accurate means for measuring the pressure, and during use be carefully watched, in order to avoid mishaps.

Fig. 101 shows a vulcanizer with safety valve, thermometer, automatic regulator and clock. This arrangement enables the operator to place the flask in the vulcanizer, close it, set the clock to the correct time, light the gas and leave the case without further attention. At the proper time the clock releases a spring which controls the gas valve, thereby shutting off the fuel supply, when the case is vulcanized.



FIG. 101.

250. A number of appliances have been devised for the automatic regulation of the supply of fuel, whether gas or oil, under the vulcanizer, and several have proven quite successful. The simplest form of these consists of a small circular metal chamber about five centimeters in diameter and one and one-half deep. It is divided into two parts by a circular metal disc accurately fitted so as to be steam tight. The upper part re-

ceives the gas through the tube *a* (Fig. 102), which is rigidly fixed to the outer shell, but by means of a thread is capable of being moved to or from the central disc *b*. The gas is discharged through the opening *c*. The lower part of the chamber is directly connected with the interior of the vulcanizer by the tube *d*.

When vulcanization is in progress the steam enters the chamber *e* and pressure is made on the flexible disc *b*, forcing it toward the inlet tube *a*, thus cutting off some of the supply of gas, and reducing the flame correspondingly. This in turn reduces the pressure in the vulcanizer, the disc moves away

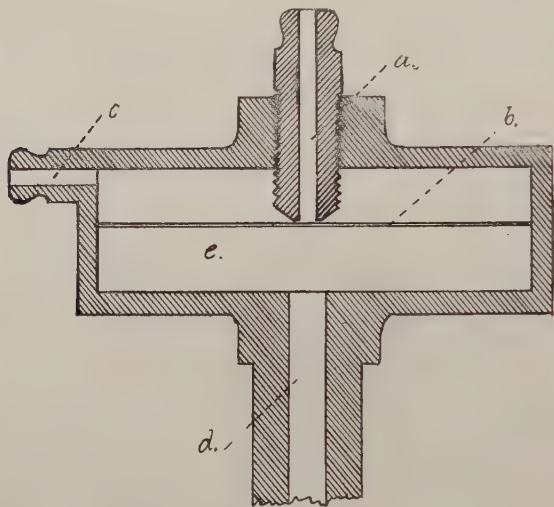


FIG. 102.

from the opening and more gas is admitted. By proper adjustment of the inlet tube it is possible to admit the exact amount of gas to maintain a uniform degree of temperature for any length of time desired. The tube is adjusted by observing the pressure as recorded by the steam gauge, or the temperature as indicated by the thermometer, and when once adjusted will require but little further attention. It should, however, be tested from time to time to verify its correctness.

251. Dental rubber can be hardened at various temperatures, but the best results are attained by gradually raising the temperature from the introduction of the flask in the vulcanizer to 300 degrees F. and maintaining this heat for one hour and

thirty minutes to two hours, depending upon the thickness of rubber in the flask. From twenty minutes for small cases, where but little bulk of rubber is present, to one hour for thick cases, should be allowed for raising the heat to the point of vulcanization.

252. If thick cases, or those that by reason of much absorption of the border are necessarily bulky, are raised rapidly and maintained at a high temperature until vulcanization occurs, more or less porosity will result, from the fact that the sulphuretted hydrogen gas in the outer portions escapes rapidly, and the rubber, hardening in this location first, forms a shell, thus preventing the escape of the gas from the deeper parts.

The gas, as it is generated in the interior of the case, if thus prevented from escaping, forms little spherical chambers, in which it accumulates, and remains confined during the entire process of vulcanization, and in finishing the denture, if much scraping is required, the porosity thus formed is disclosed. Sometimes the expansion of the gas is so great as to bulge out the shell of hardened vulcanite and distort the plaster matrix. When this occurs a reconstruction of the case is necessary.

253. It may be stated, as a general rule, that the longer the time consumed in raising case to the lowest required temperature at which vulcanization will take place, and maintaining it at this point until this change is effected, the better the quality of the vulcanite will be.

Removing Case from Vulcanizer.

254. When the case has remained in the vulcanizer the proper length of time, the heat is turned off and the appliance allowed to cool down slowly before opening it. Or, if it is necessary to open quickly, the valve for blowing off the steam should be opened very slightly and the pressure inside the boiler allowed to subside gradually. The object in slowly reducing the pressure in the vulcanizer is to allow the pressure in the flask to be gradually lowered at the same time, for should the boiler pressure be suddenly relieved before that in the interior of the flask an explosion is very liable to occur.

While this is in no way dangerous, it usually results in distortion of the plate, if not in its entire destruction by fracture.

Several cases in my own experience have occurred where the flask bolts were broken, showing the extreme interior pressure in the flask. After the steam has all escaped the thermometer cap should be screwed in place and the vulcanizer placed under the hydrant and cooled, when it can be opened.

255. Before opening the flask it should be placed in water and allowed to become perfectly cold throughout, for the reason that the vulcanite, while it is hard when cold, is not so when heated, and the denture is very apt to warp, if pressure surrounding it is relieved. When cold the bolts are loosened, the flask separated and the case cut out with a suitable knife. Care should be taken not to mar the vulcanite by careless cutting, nor let the knife strike the teeth with much force, or permanent injury may be done the case.

256. The plaster having all been removed, the plate is cleaned with water and a stiff scrub brush, by rubbing vigorously, to remove all adhering portions of the matrix. This is a good time, also, to clear all the plaster from the various parts of the flask and scrub and wipe them carefully, so that they may be ready for the next case. This can be done with very little effort at this time, when, if the flask is put away while moist and the plaster is allowed to dry upon it, the cleaning becomes a difficult matter. The surplus margins of the vulcanite are now cut away with a coarse saw or the vulcanite file, and the case is ready for finishing.

Finishing Vulcanite Cases.

257. A right and left chisel of the beveled pattern (Fig. 103), a coarse file, two or three Kingsley scrapers (Fig. 104) and some sandpaper comprise the list of instruments and materials ordinarily used for finishing the case up to the point of final polishing.

The chisels are used for giving the proper gingival curve or contour to the gums and for rounding off the angles of the vulcanite at these points.

The surplus material is also removed from all the lingual surfaces of the teeth to such point as can readily be reached with the scrapers. The margins of the pink and basic vulcanite next to the teeth should be smoothly finished to symmetrical curves and smooth lines, free from irregularities. This is

necessary, since the final polishing cannot be depended upon to remove these inequalities. The margins around each individual tooth should receive careful attention and be practically finished before passing on to the next.

258. The scrapers are now used to remove the film of discoloration, which extends over the entire surface of the denture, except that which has been molded against the silex film on the model. The pink portion is scraped until entirely free from discoloration. Any additional carving that is required should be done at this time. The lingual palatine portion of the plate should next be scraped, to present a clean, fresh surface, and if



FIG. 103.

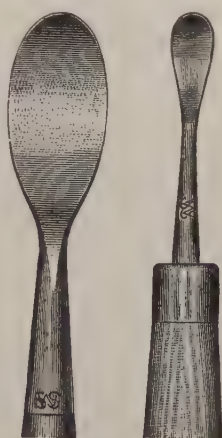


FIG. 104.

any marked irregularity in the thickness of this part not demanded by the case should exist, it should be corrected. The peripheral termination of the plate should be left rounded and smooth on labial and buccal surfaces, while the distal palatine termination should be beveled at the expense of the lingual surface, so that the tongue may not feel any abrupt shoulder at this point (Fig. 107).

259. No. 1 sandpaper is used for taking out the chisel, scraper and file marks, and this is followed by No. $\frac{1}{2}$ or 0 to fit the plate for the final polishing, with the fine grit powders used with the lathe wheels.

When much cutting is necessary the lathe burs (Fig. 105) may be used to advantage, as they cut rapidly and smoothly.

260. While using the sandpaper, and in the final polishing as well, care should be taken not to obliterate the carved prominences of the gum portion. Only the angles are to be cut away in this operation. The lathe wheels are used for giving the



FIG. 105.

vulcanite its final finish. Small felt wheels of various widths and diameters are the most convenient means for carrying the polishing powders. Pumice stone of coarse and fine grit should be used in conjunction for the same reason that the coarse sand-

paper follows the use of the chisel and scrapers. The felt wheels should be kept saturated with water and the powders kept wet also in order to develop the most rapid cutting properties of the pumice stone.

Fig. 106 represents a pair of calipers for measuring the thickness of the base-plate. It should be used frequently, especially in those cases where the rugæ of the mouth are prominent, to obviate scraping or polishing through the base-plate.

261. In handling the plate against the wheel it should be constantly moved in a sort of rotary motion to prevent the formation of grooves.

The felt wheel is followed by the single-row, stiff brush wheel, for finishing the gum margins of the pink around the teeth and of the basic material in the lingual embrasures.

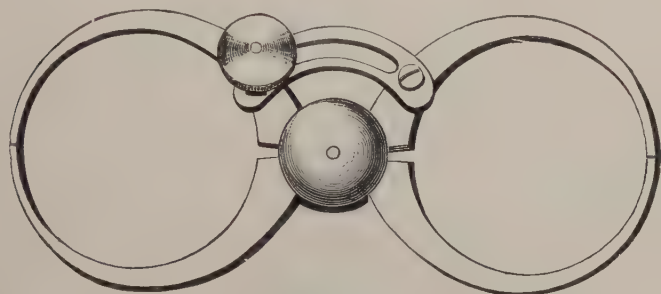


FIG. 106.

While using this wheel, the pumice stone should be kept quite wet and the position of the plate constantly changed or grooves will be formed in the vulcanite. In finishing the gum portion the teeth should be held with their occlusal or incisal faces up, as shown in Fig. 108.

262. When all irregularities and scratches have been removed with the pumice stone a final finish may be given the vulcanite by the use of whiting and water or Tripoli powder and water. This will remove the very minute scratches, imperceptible to the eye, left by the pumice stone. An extremely brilliant final finish may be given the vulcanite by oiling the plate, inside and out, dipping in dry plaster, and touching lightly to the dry brush wheel on the lathe, until all of the oil has been removed. One application of oil and two of plaster are usually necessary to give the desired finish.

263. The palatine portion of the plate should also receive some attention by removing with a scraper any nodules of vulcanite that may be present and afterward cleaning this entire surface with stiff brush wheel, water and pumice stone. The polishing should not be carried to such an extent as to change

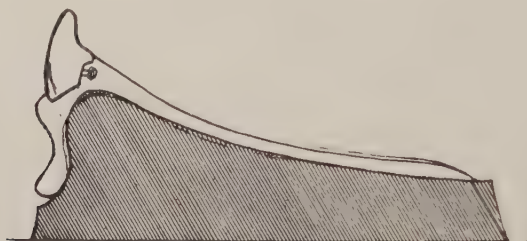


FIG. 107.

the form of this surface, but it *must* be freshened up and cleaned and rendered perfectly smooth or food will collect, and more or less irritation of the soft tissues will ensue. All surfaces, margins and points that, by their roughness, might

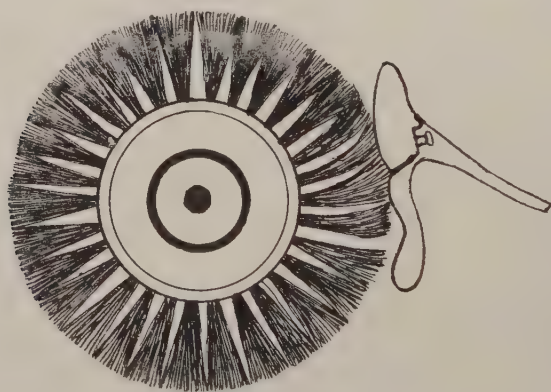


FIG. 108.

produce irritation of the soft tissues from contact, should be carefully cut away and polished.

264. It is supposed that many cases of the so-called rubber sore mouths may be due to the lodgment and decomposition of food on this surface of the plate. Roughness of vulcanite itself will cause this soreness in many cases. It is scarcely possible

that the presence of sulphuret of mercury (vermilion) will produce mercurial poisoning, or even irritation, in any mouth, as is claimed by some. It is also claimed by believers in this theory that the mercury in dental amalgam renders this poisonous and dangerous to use, but this has never been substantiated.

265. The finishing of partial dentures differs in no material respect from that of full cases. If the case has been properly waxed the only trimming necessary is to smooth the margins and freshen the surfaces of the plate by scraping. Lower partial cases, involving the replacement of the bicuspid and molars, where the band of vulcanite passes across the lingual surfaces of the anterior teeth, should be sufficiently rigid to resist stress of mastication, and consequently should not be filed and polished down too thin on this surface. The vulcanite should be allowed to come well up on the lingual surfaces of the teeth to afford a firm support to the denture, as was mentioned in the paragraphs on waxing.

266. In upper partials, where the bicuspid and molars are present, the margins of the plate along their lingual surfaces can in most cases present a bearing of one or two mm. wide, depending on the length of these teeth, to afford retention by contact with these surfaces. When a pink vulcanite gum is present it should be trimmed down at its line of contact with the natural tissues until there is no perceptible shoulder visible (see Fig. 88). No definite rules can be laid down governing the finishing of vulcanite cases, since no two are exactly alike. This much might be said, however, that *all* cases of any character should be *perfectly polished* in order to secure the best results. The first impression made on a patient's mind when a denture is submitted to them for inspection and trial, largely determines their satisfaction or dissatisfaction with the piece.

CHAPTER XL

Cast Base and Weighted Dentures.

267. Weighted lower dentures are designed to be used in those cases where the alveolar ridge is badly absorbed and where a denture of any character is more or less disturbed by the action of the tongue and cheek muscles. Dentures of this class, owing to their greater specific gravity, retain their position better than do those constructed of vulcanite alone.

The weight necessary for dentures of this class is provided for in three ways:

First—By using weighted rubber.



FIG. 109.

Second—By inclosing a bar of metal in the center of a case packed with ordinary rubber.

Third—By casting a base of metal, to which the teeth are either attached by casting the metal around the pins or with vulcanite attachment.

268. Weighted rubber consists of ordinary dental rubber of any variety in which has been incorporated coarse filings of tin or some metal that will not oxidize. The method of construction varies in no way from that of an ordinary lower vulcanite denture, except that the weighted rubber is used instead of the ordinary red or black basic material.

269. Additional weight may be given an ordinary vulcanite plate by the following method: Pack the pink rubber in place and line the lingual portion of the matrix with the basic material. A bar of tin of any form and size that seems best

adapted to the case is beaten out and bent to fit the matrix. The ends should not extend entirely to the distal termination of the matrix or the metal will be exposed when the case is finished. The bar should also be small enough and so shaped as not to interfere with the model when the flask is being closed. More rubber is now placed over the bar and the flask closed. This simple method of constructing an ordinary plate with a metallic core is oftentimes very effective, the additional weight furnishing all the stability required (Fig. 109).

Cast Metal Bases.

270. The method of construction of these cases is not complicated, but the steps vary from those of ordinary plate construction. The impression, of whatever material may have been used, is filled in with an investing material that will with-

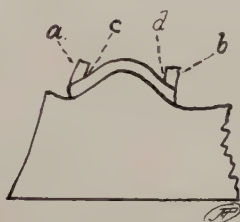


FIG. 110.

stand the heat to which it will afterward be subjected, without cracking or contracting. A number of investment compounds are sold for this purpose. Very good investments can be made by mixing about one-half to three-fifths coarse ground asbestos with one-half to two-fifths plaster, and thoroughly stirring, while dry, and afterward using in the same manner that plaster is used.

271. The details of construction of this case are as follows: Construct model of suitable investing material and mark the outline of base on it with pencil. Apply a sheet of wax, that has been warmed, over face of model and trim to the outline already marked. A rim of wax is now formed entirely around the buccal, labial and lingual margin of the base-plate, thus forming a shoulder against which the vulcanite can be finished. This rim is made by placing strips of wax from two to four mm. wide against the margin of the base-plate and burnishing

to proper form. The outer surfaces of the rim should be practically parallel with each other, so as to avoid the formation of an angle at the line of junction of the vulcanite with the metal base (see Fig. 110*ab*). Usually one thickness of base-plate over the general surface of the model, increased by the rim around its margins, and this in turn by the vulcanite attachment and teeth, will make a plate sufficiently heavy to retain its position in a comparatively flat mouth. If made too heavy it becomes tiresome and annoying to the patient, who will be unable to wear it constantly.

Between the inner surface of the rim and the base-plate a V-shaped opening can be left into which the vulcanite can be pressed, thus giving needed retention, *c, d*.



FIG. 111.

272. The waxing completed, the case is ready for flasking (Fig. 111). This step differs but little from the flasking of an ordinary case. The investment material should be the same as that of which the model was constructed. The flask used in these cases is of special construction, being made in two pieces, as shown in Fig. 112, and held together by a clamp. The top and bottom are quite open, in order that the investment may be rapidly dried out. An ordinary vulcanite flask may be used for this purpose by cutting two openings in the back part of the flask, or keeping the two parts separated at this point in making the investment, so that gates may be made to the interior matrix through which the fused metal may be poured.

273. The model is trimmed to fit the flask, so as to bring margin of the base-plate about even with the line of separation

of the two parts of the flask. After trimming it should be removed, the interior of the bottom of the flask partially filled with investment, the model moistened and pressed to place, being careful to center it evenly. When the investment has begun to set all irregular surfaces should be smoothed up and the surplus trimmed away. When fully set the surface of investment is rubbed with soapstone, which acts as a separating medium, the top of the flask placed in position and filled through the openings with investment, and the case smoothed up.

274. While filling both the first and second halves of the flask with investment, care should be taken to force it into the tubular gates through which the metal will be

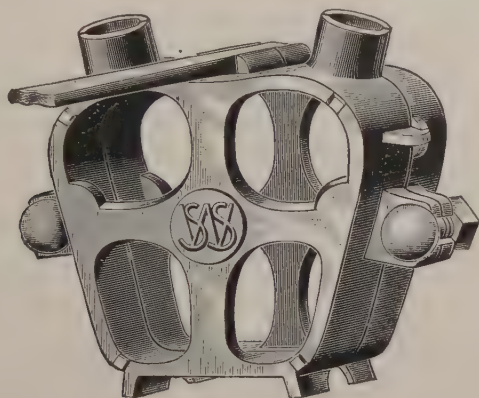


FIG. 112.

poured. When the investment in the second section of the flask has set the case should be warmed slightly, the two halves pried apart and the wax removed. Funnel-shaped gates should be cut, as indicated in Fig. 113, through which to pour the metal. If any very delicate margins of investment are present around the margin of matrix they should be trimmed away. The flask is now fitted together, the clamp adjusted, the joint between the two halves of the flask luted with a paste of one-half soapstone and one-half plaster, and the case set over a slow flame to dry out.

275. The condition of the investment may be tested from time to time by holding a piece of polished cold steel or glass over the openings or gates in which the metal will be poured.

If any moisture is present it will condense upon the cold surface thus applied. The heating should be continued until all moisture is expelled, in order to insure a perfect casting. When thoroughly dry the fusible alloy is melted and poured into one of the openings. If case is sufficiently hot, the molten metal will fill the matrix perfectly, and rise in the opposite opening, thus indicating that the interior is full. If the investment has cracked while drying out it is a good plan to surround the entire flask except the openings with molding sand, packing it sufficiently tight to prevent the escape of any of the

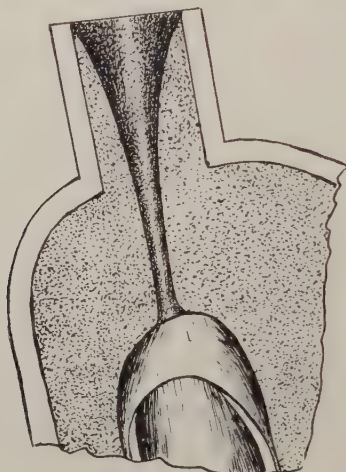


FIG. 113.

metal through the cracks. If this precaution is not taken the metal will all run out or the matrix be only partially filled.

276. As soon as the metal has crystallized the flask can be pried apart, the case removed, the metal which filled the gates cut away and the file used for trimming off the surplus margins. When properly trimmed and polished a wax rim is built upon it as in ordinary base-plate work, and the relation of the lower to upper jaw secured, as previously outlined. The case is then mounted on the occluding frame and carried forward as an ordinary vulcanite denture would be, the base of metal bearing the same relation to the case that the base-plate ordinarily does.

277. In addition to the grooves formed by the junction of rim with plate, the surface on which the vulcanite rests should

be spurred with an engraving tool to afford a still stronger attachment to the metal base. In flasking, the line of separation should occur at the margin of the rim, the metal base remaining in the lower or first section of flask.

Fusible Alloys for Cast Base Dentures.

278. A number of alloys, the formulæ of which are secret, are made for constructing cast base dentures. Most of them consist largely of tin, with something added to increase the toughness, impart rigidity and prevent discoloration of the basic metal. Dr. Kingsley gives a formula for weighted bases which fulfills the requirements very well. The following list comprises the most important of these alloys:

Kingsley.....	Tin 16, bismuth 1.
Another.....	Tin 16, cadmium 1.
Reese's.....	Tin 20, gold 1, silver 2.
Bean's alloy.....	Tin 95, silver 5.
Kingsbury.....	Tin 16, antimony 1.

Reese's alloy is especially recommended for the construction of full upper bases, as it possesses sufficient integrity, even in thin plates, to withstand ordinary stress.

Cast Aluminum Bases.

279. These bases are usually used for full upper cases on account of their extreme lightness. As a rule, however, the heat to which it is necessary to subject the investment of the case is usually sufficient to produce more or less change of form in the model, so much so that in many cases a misfit results. The waxing of a case for cast aluminum base is similar to that of a lower weighted base. The rim of wax is extended around labial and buccal surfaces, across the tuberosities and around the lingual surface of the case at such point as will admit the union of vulcanite attachment to base, without an angle being formed. One thickness of ordinary base-plate should be sufficient in forming the matrix.

280. The flask used for this purpose is one of special construction. It usually has attached to it a crucible for holding the metal while being melted, and from which it is run immediately into the matrix. This crucible should be set at a little distance above the matrix, in order that the weight of the

metal, pressing from above, may insure a perfect filling of the interior of the flask. The case, having been waxed, is invested in the ordinary manner in the first half of flask and a small roll of wax extended from waxed base-plate to the opening of the crucible. The upper half of the flask is placed in position and the two locked together and placed on the stove to heat. It is unnecessary to open for the removal of the wax, providing the gates are open and free, for upon heating, the wax will disappear in the investment. The flask is placed on a special stove, the flame of which is directed against its sides. A second burner, placed above the first one, heats the crucible containing the ingot of aluminum. When all is ready and the metal melted, it can be settled down into the matrix by slightly tapping on the side of the flask.

281. Sometimes air pressure is used to assist in forcing the metal into place, but if the gates are sufficiently large and the case is heated sufficiently this is not necessary. No special directions are necessary in finishing the base. The surface of the plate against which the vulcanite will be molded should be spurred as mentioned in the previous case.

The inner margin, or that angle against which the vulcanite will terminate, should be formed in pleasing curves, with sharp and well-defined margins. In this class of denture, as well as all other cases of cast bases, the two halves should be as nearly symmetrical in outline form as is consistent with the form of model, in order that the highest artistic results may be attained.

282. Cast aluminum bases have not proven very successful up to the present time for two reasons, first, because of perceptible shrinkage in the model in casting; second, because of the imperfect density in the cast base, most of these cases showing numerous minute spaces into which the fluids of the mouth penetrate, causing disintegration of the material in time.

CHAPTER XII.

Repairing Vulcanite Dentures.

283. The most common accidents that occur to vulcanite dentures are fractures of some portion of the base-plate, or breaking or loosening of a tooth or teeth, or a combination of these several mishaps.

Repairing a Broken Base-Plate.

284. In almost all cases of repairs of this class it is necessary to secure a model for holding the broken pieces in proper relation to each other. Sometimes it is necessary to take an impression of the mouth, secure a model from this, and place the plate in position upon this model. Ordinarily the broken pieces can be brought together in proper relation and held by melting sticky wax across the break and allowing it to cool, when a model can be secured by filling in the palatine side of the plate. This surface should be oiled, in order to more readily effect the removal of plate from model, in case it is found necessary to remove it.

285. Perhaps the subject of repairs can be best illustrated by describing in detail the methods followed in certain classes of cases. Take, for example, an upper denture broken in the palatine portion, the fracture extending from the central interproximate space through to the distal margin. The first step would be to see that the fractured surfaces were free from all debris, and whether it were possible to bring and hold the parts together in proper relation to each other. If so, they are approximated, and sticky wax melted over the joint, care being taken that none enters it or the correct relation of the parts will not be secured. The wax should be allowed to cool before relieving the pressure that was exerted upon the sides of the plate in bringing it together or the tendency to spring apart may overcome the adhesiveness of the wax. When cooled the joint should be closely examined, and if parts are in correct

relation to each other the palatine surface should be oiled and a plaster model secured.

A sharp-pointed instrument should be used to cut two shallow, delicate lines from the front to the back of the plate on the lingual surface, parallel with, and on either side of, the line of fracture. These lines should be laid about 10 mm. apart, or 5 mm. on each side of the break, as indicated in Fig. 114. They mark the outline limits of the surface of old vulcanite to be removed. Instead of sawing out the section thus indicated, or cutting dovetailed notches in the alternate sides as is frequently done, the surface is gradually beveled from these shallow lines on the lingual surface, through to the palatine surface, as indicated in the enlarged sectional drawing (Fig. 115). The beveling should be evenly and uniformly ac-



FIG. 114.

complished, cutting out the least amount of vulcanite at the lines *a a* and the greatest amount at the line of fracture *c*. The excavated portion is waxed in smoothly to the thickness that it is desired the new vulcanite should be, the case invested low in the flask and the gums and teeth covered by the investment, thus leaving only the lingual surface of the denture exposed. The surplus plaster is trimmed away, the smooth surfaces varnished and the completion of the flasking accomplished in the ordinary manner.

286. When the plaster has set, the case is separated, the wax removed and the freshened surfaces of vulcanite covered with a thin film of chloro-rubber or rubber cement. Rubber of the same color as the base-plate is now packed over this surface, placing in enough to insure a slight excess. The flask is

closed and vulcanized as in ordinary cases. In finishing, the scrapers are used to trim away the excess of new vulcanite that overlaps the relieved surface of the old plate, so that no thin, delicate margins may be present to peel up and roughen under wear.

287. It is not a generally understood fact that a *perfect union* may be secured between the surfaces of old and new vulcanite if proper steps are carried out. The conditions necessary to secure a perfect union or fusion of old with new



FIG. 115.

vulcanite are a perfectly clean, fresh and slightly roughened surface to the old vulcanite, although the last condition is not essential, the interposition of a little chloro-rubber and the application, under pressure, of clean, fresh rubber to the freshened surfaces of old vulcanite.

As before stated, the method of cutting dovetailed spaces or drilling holdes near the line of fracture, without uniformly reducing the amount of old vulcanite, is not a satisfactory way of making repairs of this class.

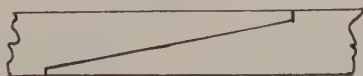


FIG. 116

Figs. 116 and 117 show the principle of splicing, as applied to the joining of heavy pieces of timber, and the same rule is applicable to repairing dentures. It does not take the eye of an artisan to see that 116 is stronger than 117 and more sightly.

288. In case the plate is entirely broken apart, and a repair of the gums is required, the same sort of repair should be made on that surface as in the palatine portion, with this exception, namely, after beveling away the old gum from both sides of the break, apply the chloro-rubber (pink), and then

the pink rubber in the form of triangular pieces and strips, bur-nishing to the form of the gums until the portion cut away is fully restored. This is best accomplished after waxing to-gether the lingual surface, and while the case is on the model. In investing the case, the gum portion is covered by the plas-ter in the lower half of the flask, in the same manner that the



FIG. 117.

case is invested when this surface is unbroken. The subse-quent steps are carried out as outlined for the first case men-tioned.

Since but little, if any, perceptible shrinkage takes place in the pink vulcanite during vulcanization an absolutely perfect joint is secured, if the new material has been perfectly bur-nished to the old.

Extension of Bevel in Gum Repairs.

289. When the break in the gum portion occurs on the front of the denture, anywhere between the six anterior teeth, it is a good plan to extend the bevel from line of fracture to some point back of each cuspid, although by so doing the bev-eled portion on one side of the break may be much more ex-tensive than on the opposite side. The object in doing this is to locate the lines of junction of new with old vulcanite, where they will not be noticed to any extent, since in vulcanizing new to old pink more or less discoloration is certain to occur, and no means are known for preventing it.

Replacing Porcelain Teeth—Full Cases.

290. In placing a tooth, on a full denture with pink vul-canite gums, care should be taken, in cutting out the pins of the old tooth or in removing the vulcanite from lingual sur-face, not to mar or disfigure the gum margin in any way. If care is taken in this step no replacement of pink vulcanite will be necessary, and consequently no discoloration will occur. That portion of the vulcanite which surrounded the pins of

the old tooth should be removed with a file or burr, cutting this surface, at a bevel sufficiently great to permit the new tooth to be set in position without this surface interfering with the pins. The cervical portion of the tooth should be accurately fitted to the cervical margin of pink gum, which is still intact.

The tooth, when fitted, is waxed in position and the case invested, covering everything but the wax and a small surface of the old vulcanite immediately surrounding it, with the plaster investment, in the first half of the flask. The second part is placed in position, filled, allowed to set, then separated and the wax removed with hot water. The beveled surface is covered with a film of chloro rubber, new rubber is packed in and the flask closed. The case is vulcanized the usual length of time if ordinary dental vulcanite rubber has been used for packing.

A rubber which vulcanizes in from 15 to 30 minutes is made for repairs, but it is not so tough nor of as good quality as the regular variety, and its use is not recommended.

Replacing Porcelain Teeth—Partial Cases.

291. When the tooth to be replaced has been ground to fit the border and there are no proximating teeth present, it will be necessary to take an impression of the mouth with the denture in position. A modeling compound impression and

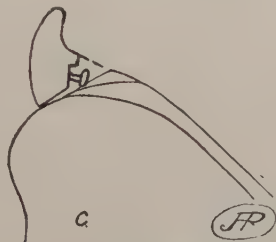


FIG. 118.

bite, combined, will usually answer the purpose. The denture, if it does not come away with the impression, is placed in it, the latter filled, the model secured and mounted on the occluding frame. A tooth is selected, the old vulcanite beveled so as to receive it, and the porcelain ground to meet the requirements (Fig. 118). The tooth is then waxed in position and

the case invested as already outlined, entirely in the lower half of flask. It is a good plan to bevel the vulcanite before taking the impression, as this obviates the marring of the plaster model—a mishap that frequently occurs in cutting out the old pins.

292. Frequently the space between the incisal ends of the opposite teeth and the border is so close that the vulcanite

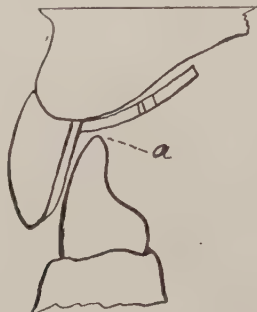


FIG. 119.

which passes through to carry the tooth has not sufficient bulk to withstand the stress. When this condition is present the difficulty may be overcome by selecting and grinding a plate tooth to fill the space and backing it with gold (Fig. 119). To the angle at the junction of the ridge lap with the lingual surface a piece of 24 or 22 gauge clasp metal is soldered at right angles to the backing *a*. This should be



FIG. 120.

long enough to pass through the space to be filled and find a firm attachment in the body of the denture.

It should be notched on its sides and have one or two holes punched in it, the margins of which should be countersunk to afford a means of anchorage in the vulcanite (Fig. 121). The tooth having been backed, and the gold anchor bar bent to conform to the palatine curvature of the denture, it is waxed

in position and invested so as to be retained with the model and base-plate in the lower half of flask. The succeeding steps are similar in every respect to those already described.

Repairing Lower Partial Dentures.

293. In lower partial cases, when the anterior natural teeth are present, the strip of vulcanite which passes across the lingual surfaces of the teeth, connecting the parts of the plate carrying the teeth, is frequently broken. The long bevel splice, already described, is used in these cases. The bevels should frequently be extended 4 or 5 mm. back of the last natural tooth on each side, although this is not necessary, except in those cases where the old strip is thin and weak throughout its entire extent. Sometimes a strip of flattened wire or stiff plate is vulcanized in the body of the new rubber to afford greater strength than the vulcanite alone furnishes.

294. This strip should be of some metal that will not oxidize during vulcanization, consequently a steel wire cannot be used unless plated with copper, tin or gold. Clasp metal is perhaps the best, since it does not oxidize and its elastic properties are all that could be desired. German silver wire can also be used, as can also irido-platinum or platinoid. The latter, however, is only a high grade of German silver. Coin silver or silver in any form cannot be satisfactorily attached to or in vulcanite on account of the great affinity of this metal for sulphur. During the process of vulcanization a layer of silver sulphide is formed over the surface of the metal and the vulcanite seems also to be disintegrated by the chemical action that occurs.

Substitution of New for Old Base-Plate.

295. Sometimes it is desirable or necessary to replace the old base-plate with a new one when it is not possible to obtain a new impression of the mouth. In such cases it is supposed that the occlusal conditions are correct. The first step in such case is to attach the pieces together if plate is broken, or, if not, to cover the palatine surface with a thin film of oil and secure a model. This is now mounted on the occluding frame and allowed to set. The teeth are oiled slightly, a mix of plaster made and placed upon the lower bow of occluding frame, building it sufficiently high to receive the teeth.

The upper part of the frame is now closed and the teeth imbedded in the plaster attached to the lower bow. When set, the occluding frame is opened, the plate is removed, heated and the teeth pried off. These are now set in their respective impressions in the matrix, on the lower bow of the frame. Wax base-plate is placed on the model, a roll of wax arranged on the ridge and softened and the upper half of frame closed, using force enough to imbed the cervical ends of the teeth in the wax roll. After the wax has cooled the case is opened and the teeth will be found to adhere to the base-plate. The case is then waxed up and completed in the usual way. The occlusion is tested by trimming the matrices so as to allow the teeth to readily pass in and out, and trial made as often as seems necessary. While this is the reverse of ordinary conditions, it is accurate and practical.

Using Plate for Impression Tray.

296. A simple method of making over a full denture is as follows: Into the old plate is evenly distributed a thin film of impression plaster, the case introduced into the mouth and the patient instructed to close tightly so as to force out as much excess material as possible. When set the plate is removed, the plaster covered with a film of separating medium and a model secured. The steps from this point are precisely the same as in the case just outlined or the ordinary steps can be fully carried out.

Replacing a Tooth Without Vulcanization.

297. Long-continued vulcanization deteriorates the quality of dental rubber, and as a consequence each time a repair is made the vulcanite becomes more brittle, until at last it practically loses its elasticity and will readily break under very moderate stress.

When a denture which has already been repaired a number of times requires the replacement of one or two teeth, and these teeth are supported on their labial or buccal surfaces by a margin of vulcanite gum, the repair may be made in the following manner, without subjecting the plate to another vulcanization. The tooth is fitted in precisely the same manner as already described. The vulcanite inclosing the old pins is cut away with a file in such manner as to form a dovetailed

space in the base-plate, the sides and base of which may be roughened slightly to afford a firm anchorage to the metal which will afterward fill this space (Fig. 121). The tooth is now waxed in position and plaster is built up against its outer and over the occlusal or incisal surface of this as well as the adjacent teeth. This forms a matrix which holds the tooth firmly in place during the subsequent steps. A few small pieces of fusible metal are now placed around the pins in the dovetailed space and melted by the application of a blunt, hot instrument. While in the fused state it is packed closely around the pins and into every part of the dovetail. Enough

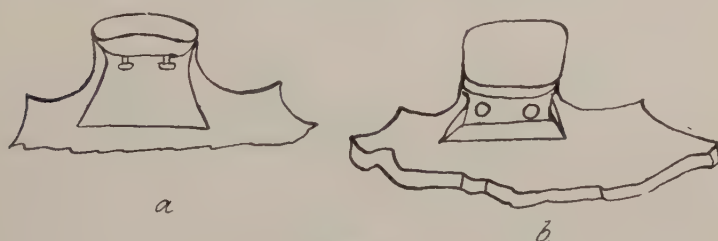


FIG. 121.

is added to raise the margins of the metal slightly above that of the matrix. When cold the surplus is dressed down with discs and polished.

An alloy to be used for this purpose can be made by combining the following metals in the proportions given: Bismuth 8, lead 6, tin 2. This alloy melts at 205 degrees F. Amalgam can also be used for the same purpose, and as a rule will give as good results. It should be allowed to set perfectly before removing the matrix and polishing.

Repairs of this class are not recommended except for temporary work or in case of old plates that have been repaired a number of times, or for replacing teeth on old celluloid cases.

Repairing Gum Section Cases.

298. When a gum section is broken from a plate, the porcelain itself or the pins having broken, a new block must be selected that will conform as perfectly as possible in form, size, color, length of bite and curvature of labial or buccal surface to the broken section. Usually this is a difficult mat-

ter, and too much care cannot be bestowed upon this step. As a rule, in repairs of this class it is a good idea to cut away the vulcanite in which the old pins are inclosed, place the plate in the mouth and take a bite. The case is mounted on the occluding frame. Then the block is selected and ground to fit the ends of the proximating sections. The block, if thick, may require dressing down on the surface that forms contact with the plate. The waxing, vulcanizing and finishing is accomplished in the ordinary manner.

Rubber Cement.

299. In making repairs where new and old vulcanite are to be united, a rubber cement must be used between the surfaces in order to secure absolute molecular union. Cement may be made in two or three different ways. The most common method is to dissolve pure rubber or soft vulcanite in chloroform, bisulphide of carbon, or benzine, any one of which is a solvent. It is a good plan to keep a small bottle each of red, black and pink chloro-rubber in the laboratory and use that color which corresponds to the base-plate or rubber to be used in making the repair.

CHAPTER XIII.

Celluloid Dentures.

300. Celluloid, while not as durable a material as vulcanite, for base-plates for artificial dentures, presents a much better appearance because it more nearly approaches the natural gum tissues in color and general esthetic requirements than any other substitute except porcelain.

301. In 1855 an Englishman named Parks first invented the material now known as celluloid, and which he called *Parksite* or *zylonite*. The Newark Manufacturing Company, which was organized in this country in 1869 by J. S. Hyatt, about this time began, and for a number of years continued, a series of experiments with celluloid with a view of perfecting this material and discovering its possibilities and limitations.

After a lapse of several years and the expenditure of large sums of money, during which time many almost insurmountable difficulties were met and overcome, a product of stable character was produced which was suitable for almost innumerable purposes and which brought the company, in time, fabulous financial returns.

302. Celluloid is made from *pyroxylin* or the woody fibre of plants which has been treated with nitric and sulphuric acids, after which it is known as *nitro-cellulose* or *gun cotton*, a highly explosive substance.

The proportions of this material as used for dental base-plates are about as follows: Gun cotton 100 parts, camphor 40, white oxide of zinc 2, and vermilion .06.

303. There is very little difference, in reality, between celluloid and zylonite in general appearance, except that the latter is possibly a little more translucent and in color shows a slight purplish tinge with a less pronounced pink than celluloid. The translucent effect may be due to the difference in manufacture, since *zylonite* is made from *collodion*, or gun

cotton, after it has been dissolved with ether or wood alcohol, while celluloid is made directly from the gun cotton, the union of the several ingredients being effected by heat and pressure.

304. The following abbreviated description of its manufacture is taken from the *Dental Cosmos* for January, 1875, that journal having reprinted the article which appeared in the *American Artisan*: "After the pulp is ground in the beater engine, and the camphor and whatever coloring material may be desired are thoroughly incorporated with it, the substance being kept meanwhile at the proper temperature, the superfluous water is removed by pressure and absorption, a peculiar porous material, made especially for the latter purpose, being employed.

305. "During the process of drying under pressure and absorption the material becomes nearly converted, so that it is no longer nitro-cellulose, but imperfect celluloid. In so far as conversion has taken place, its properties have undergone a total change. All that remains to convert it into the various articles referred to is manipulation under heat and pressure, during which the chemical combination is completed.

306. "For some qualities of the material desired to be produced a small percentage of alcohol is added in the subsequent manipulation. As evidence that there is a perfect chemical combination, and not a mere mechanical mixture of the materials, the fact may be stated that whereas camphor in its uncombined state is an extremely volatile substance when exposed to the air, in its combination with nitro-cellulose it loses this property altogether. An enumeration of the properties of the material which we shall give anon will be further proof of the chemical combination.

307. "When the material is properly converted comparatively no shrinkage takes place. There is no escape of the camphor unless an excess has been employed, and in that case the excess of camphor will escape from the surface of the celluloid; but whatever uncombined camphor remains in the interior is so closely imprisoned by the solid surfaces that it cannot escape. By varying the proportions of the excess of camphor different degrees of solidity and flexibility are obtained. . . .

308. "Without the admixture of coloring matter it has a

pale amber color. If it is desired to make the material white like ivory, oxide of zinc is used, and for other colors various mineral pigments are incorporated with it, or dyes soluble in alcohol, or any of the aniline dyes, may be caused to permeate the material to give it any desired color. It is hard and elastic, having a hardness ranging from horn to that of ivory. It is as tough as whalebone. In elasticity it greatly exceeds ivory.

"Celluloid is also a very fair non-conductor of heat and electricity, not quite so much so as hard rubber, but approximating the latter very closely in this particular.

309. "While it is so good a non-conductor, it is not perceptibly electric.

"But perhaps the most remarkable property of this otherwise very remarkable material is the fact that it becomes plastic at a temperature of from 250 to 300 degrees F., and this property enables it to be molded with facility into a great variety of forms for ornament and utility. Pure celluloid has a specific gravity of about 1.4.

"A profitable and successful industry based upon these properties of celluloid is the manufacture of dental plates. The material can be made precisely the natural color of the palate and gums.

310. "It is much stronger than rubber and has a perfectly clean surface. It may be more easily manipulated than rubber, as it does not require to be vulcanized. It possesses all the valuable qualities of rubber for dental purposes without its defects. It requires only about one-sixtieth as much vermilion to give the proper color to celluloid as is required to impart the usual color to rubber. The danger of salivation, which sometimes occurs in the use of rubber for dental purposes, is, therefore, obviated. The difficulties encountered in the application of celluloid to dental plates have been very great and many failures were at first experienced, but with untiring perseverance the inventors have pursued the subject until, during the last year or two, they claim to have produced an article possessing all the requirements desired, not a single failure having been experienced through any fault of the material made within a twelvemonth past."

311. The foregoing claims are somewhat exaggerated in

some respects, but, taken as a whole, the description of this material is an admirable one. Just about the time celluloid came into use much litigation was in progress between the Goodyear Rubber Company and members of the dental profession, who refused to pay a royalty to the above-named company for the privilege of using vulcanite rubber for dental purposes. At that time celluloid was welcomed and widely used, but owing to the fact that its properties were not fully understood and that the methods of manipulation were faulty, many failures have been recorded against it. These failures may be mentioned and the causes explained.

312. First: In some cases there seems to be gradual solution of the substance by the fluids of the mouth, which results in the thinning and consequent weakening of the base-plate. The material around the pins of the teeth is gradually dissolved away, thus allowing the latter to become displaced under stress of mastication.

313. Second: When worn for some time the base-plate emits a very strong and disagreeable odor. So much so as to render the wearing of the denture impossible.

314. Third: Discoloration, especially in the mouths of smokers.

315. Fourth: The difficulty met with in securing accurate adaptation of the denture to tissues of the mouth, owing to change of form of model on which case is pressed.

316. All of these conditions mentioned are undoubtedly the result of faulty principles in pressing. When this material first came into use, in manipulating it was immersed in an oil bath and pressed under great heat. Then the glycerin process was suggested, and afterward steam was used. In none of these processes were the volatile constituents driven off to any extent, but, on the contrary, every opportunity was given the material to absorb foreign matter, which in time washed out and allowed particles of food and saliva to be taken into the spaces thus left, and which resulted in the bad odor mentioned, and the final disintegration of the material itself.

317. It has been found that the best results can be attained by pressing celluloid in a dry chamber at a high temperature. By this process the volatile constituents are driven off and the material rendered more dense and compact than by any of the

other methods mentioned. It will take a finer finish, is more elastic, has a better color and will wear longer and resist the action of the fluids in the mouth more perfectly than if manipulated in a bath of any sort.

318. Steam oil and glycerin soften the plaster model and investment, and under heavy pressure the model is changed in form so that misfits frequently occur. When dry heat is used the moisture is all expelled from the model and investment as well, and little, if any, danger of change due to pressure is observable.

319. The chief objection to the dry method is due to the danger of burning the blank during the process of pressing.

320. By cutting ample waste gates in the plaster investment so that no waste material may come in contact with the metal flask this danger is largely overcome. An extra large-sized flask is necessary in order to afford the needed space for deep and wide gates.

321. The flask should be of the same general form as a vulcanite flask, but the guide pins should be strong, and long enough to hold the two halves of the flask in proper relation to each other when separated by the introduction of the unpressed blank, as shown in Fig. 122.

Flasking.

322. Upper cases should be invested in the shallow part of the flask, with the anterior part of the model more or less elevated so as to insure at least a parallel condition of the several faces of the model with the pins, or the direction in which the two halves of the flask must travel in closing. Should undercuts be present the material may fail to find its way into them, or the matrix itself, on account of the margins of the matrix cutting off the material before it is carried to position. This is caused by the model approaching too close to the margins in the closing of the flask. This difficulty can be overcome by placing the model in proper position, or at a proper inclination, when investing it.

323. Coarse plaster-of-Paris should be used for investment purposes, as it withstands high pressure, without yielding, much better than impression plaster.

324. The waxing of cases for this class of work is the same

as for vulcanite work, with this exception, that over the palatine surfaces of upper cases the wax can be applied in an extremely thin layer, since this portion of the case invariably

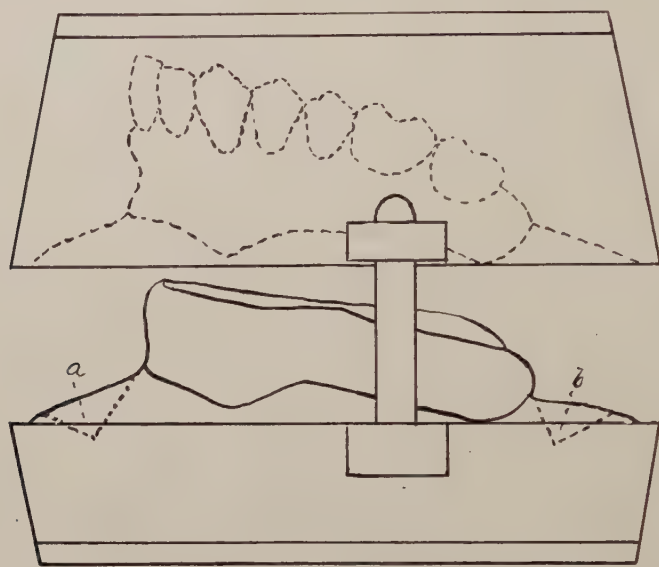


FIG. 122.

thickens somewhat in pressing. After the flask has been separated, and the wax removed, the next step will be to cut the waste gates.

Waste Gates.

325. These should extend entirely around the model so that any excess material from any side may be caught and prevented from coming in contact with the flask. The outer margin of the gate should be at least 3 mm. from the inner margin of the flask. The inner margin of the gate should approach within 1 m. of the peripheral margin of the waxed case, and the plaster between these two lines cut out in V-shaped form as shown at *a* and *b*, Fig. 122. The gates having been cut and the wax removed with boiling water, the next step will be to paint the face of the model with collodion to give the finished case a smooth surface when pressed.

Selection of the Blank.

326. The blanks come in various sizes and are numbered as follows, beginning with the smallest, No. $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, $6\frac{1}{2}$. These are sufficiently thick to insure a surplus of material of ordinary cases. When a large amount of absorption has occurred it is sometimes necessary to use a thicker blank than those mentioned. For such purpose a set of extra thick blanks are made and numbered as follows: $2\frac{1}{2}a$, $3a$, $3\frac{1}{2}a$, etc., up to $6\frac{1}{2}a$.

327. When using upper blanks of this variety it will invariably be necessary to reduce the palatine portion to a reasonable thickness with a lathe bur, shown in the illustrations in a preceding chapter, otherwise the case would undoubtedly be distorted in pressing, on account of the excessive amount of material.

328. Oftentimes it will be necessary to modify the form of a blank so as to conform to the case before attempting to press. This is done by placing it in boiling water until heated through, and with the blank laid on a flat surface bend the outer rim with pliers or depress the palatine portion of the upper cases with a rounded wood handle until it is conformed in a general way to the model. It may be necessary to heat it two or three times in order to accomplish this step.

329. Usually during this operation the blank will become more or less soiled. When this occurs it should be cleaned and freshened by scraping and afterward painted with a solution of spirits of camphor, which will prevent any tendency of the material to flake or check during the pressing process. The blank is placed upon the model and the opposite half of the flask set in position on the guide posts and dropped down until in contact with the blank. Care should be taken to see that the blank is not displaced during this step. The case is now ready for pressing.

Pressing the Case.

330. The press used should be of the dry chamber variety, for reasons already mentioned. The flask should be set on the bed-plate of the press, with that side which contains the teeth down, so that in case any of the teeth become loosened in the dry heat, gravity will retain them in position.

331. Heat should be gradually applied until the thermome-

ter registers a temperature of 300 degrees F., at which point it should be maintained during the pressing process. At least twenty-five minutes are required to bring the case, in its interior, up to this temperature.

The bolts are now gradually tightened and the flask closed. Care should be taken to keep the bed-plate parallel with the top portion of the press so that the guide posts of the flask will not be bent. The case should be lifted out from time to time for examination.

332. Too much pressure should not be applied at any time. Celluloid, even when plastic, is rather sluggish and flows slowly, so that a moderate degree of maintained pressure will give better results than extreme and sudden pressure. Too much force usually results in distortion of the model and a consequent misfit of the denture.

When the flask is closed the source of heat may be cut off and the case allowed to cool for ten or fifteen minutes or longer if time permits. This allows the molecules of the material under continued pressure to adjust themselves to each other and lessens the danger of warpage which sometimes is noticeable when pressure is relieved too suddenly. In every case the flask and contents must be perfectly cold before the press bolts are loosened.

333. In removing a case from the flask it will be found that the plaster investment and model is extremely hard and difficult to cut. If a hammer or mallet is used to knock the investment out of the flask, some of the teeth are very apt to be fractured. Therefore it is best to remove the case by cutting, even though it is more tedious.

334. No special directions are necessary for finishing celluloid cases as this material is susceptible to the same methods of polishing as vulcanite. Should there be any decided odor of camphor present it can be removed by soaking the case, after finishing, in a ten to fifteen per cent solution of sulphuric acid. A stronger solution of this acid would in time entirely dissolve the base-plate.

335. As before stated, celluloid is not as a rule as durable a material as vulcanite, but it certainly deserves some consideration as a serviceable and inexpensive base for dentures

because of its beauty and close similarity in appearance to the natural tissues.

336. It is peculiar and must be thoroughly understood to secure the best results. Those who have used it and become familiar with its physical properties use it more frequently than vulcanite, particularly in full upper or lower cases. Partial dentures of this material are not recommended as a rule, for the reason that single or isolated teeth are more readily displaced than when vulcanite is used.

CHAPTER XIV.

Construction of Swaged Base Dentures.

337. In the construction of dentures with swaged metal bases the preliminary steps of taking the impression and forming the model are carried out as described in a former chapter. The essential points of model construction should again be briefly mentioned here.

Preparation of Models for Full Cases.

In full cases the sides of the model should flare from the extreme marginal outline of the alveolar border to the base of the model. The divergence of these sides should not be too marked, nor prominent, and yet they must be sufficiently so to permit the ready removal of model from sand matrix without distorting the latter.

338. An angle of 70 to 80 degrees formed by the junction of sides with base will in most cases give the proper flare required. The model should be as thin as possible to be consistent with the stress to which it is to be subjected in forming the matrix. In upper models the palatine portion in its thinnest part should be not less than six or seven mm. thick. The same rule will apply to the construction of lower models of average width. Extra wide models, either upper or lower, should be correspondingly thickened. Usually it is best to elevate the anterior part of an upper model slightly above the posterior portion, so that in throwing it from the sand the matrix will not be marred.

339. Models in which there are marked depressions in the region of the incisive fossæ may, when so formed, be thrown from the sand in most cases without difficulty. When, however, these depressions are so marked that the distance from their bases through to the palatine surface is less than the width of the alveolar border between that point and the occlusal plane, cores must be constructed as described in Chapter

V, paragraph 129. Very often, when slight depressions are present, they may be filled in with wax or plaster, so as to dispense with the use of cores. In swaging the plate, it is trimmed so as to terminate at the margin of the undercut without entering it, and in attaching the teeth the vulcanite which forms the gum can be extended up beyond the margin of the plate so as to perfectly fill the depression.

340. Another reason for elevating the anterior part of the model is to throw the thinnest part of the palatine portion to the extreme distal margin, so that the sand matrix will be the highest at this point. If lower along this margin than in the central palatine portion, the steam or volatile products in the sand accumulate here and often produce marked imperfections in the die.

341. Another method of securing an accurate matrix in the sand when undercuts are present on the model is by the use



FIG. 123.

of the Hawes flask. (Fig. 123.) This consists of a sectional ring with projections extending from the inner periphery toward the center. The model is placed in the ring and should be slightly higher than the latter. Sand is packed around the sides of the model and carried above all undercut surfaces, leaving the face of the model exposed. Charcoal is then dusted over the same and the second portion of the ring set in position. Sand is packed in this and when condensed this ring is removed. The sectional ring is now opened and the model removed, after which the sections are pinned together again, the full section or that last filled is placed in position and the two rings inverted. If the steps are properly carried out a perfect sand matrix will result.

• Preparing Models for Partial Cases.

342. In constructing a model for a partial case, only that portion of the face designed to be covered by the plate need

be preserved. The outer surfaces may be given the proper flare by trimming or building out with plaster. The portion of the model around the anterior teeth should be thickened slightly by the addition of plaster, while if the bicuspid or molars are present their buccal surfaces may be trimmed away slightly so as not to make the model too bulky at these points.

The trimming of the model on all surfaces but the face



FIG. 124.

should be neatly and carefully accomplished, and finally finished with fine sand paper. It is then varnished with a thin coat of shellac and after this has been allowed to dry the surfaces are thoroughly rubbed with soapstone, to prevent the sand from adhering to them.

Forming the Sand Matrix.

343. These details having been carefully carried out the model is set base down, on a plane surface and the molding ring is set over it, being careful to place it so that the model is in the center (Fig. 124). The ring should be from one to two centimeters larger, peripherally, than the model, in order that the sand may be evenly and uniformly packed into it and over the model.

344. Fine sifted sand, free from all lumps and impurities, and prepared by mixing with oil, glycerine or water to make it coherent, is used for the matrix. The sand may be tested by compressing a handful and breaking the lump thus formed, when it should show a clean fracture. If too much moisture is added the molten metal, when poured upon it, will generate a large amount of steam, and this, in turn, will produce a rough surface on, or decided imperfections in the die. The

sand prepared and sold by the supply houses is much more satisfactory than the ordinary sand to which water is added, since the former is usually much finer than the latter and is always ready for use.

345. The sand is placed in the ring around and over the face of the model, enough being introduced to cover it slightly. Pressure is made on the sand around the outer side of the model, somewhat in the direction of the sides of the ring, rather than downward, in order to make it adhere to the ring. Moderate pressure only should be made over the face of the model or the sand will become so condensed in the irregular surfaces and inequalities of the palatine portion that it will adhere and come away when the latter is dislodged, thus producing imperfections in the matrix. More sand is now added and the packing continued until the ring is entirely full. A straight edge is now passed across the top of the ring to remove the surplus sand. The ring, with contents, is turned over and the sand around the margin of the model is removed to a depth of one or two mm. so as to relieve its hold upon the model at this point, and also to prevent the margin of the matrix from breaking.

346. The base of the model is now tapped, slightly and evenly, in order to loosen it in the matrix. Care should be taken not to use undue force in doing this, or the matrix will be distorted. The object is to produce a slight vibration, just sufficient to break up any adhesion of sand to model without distorting the former in the least. If distortion should occur the die will be imperfect and the fit of the plate will be impaired.

347. The model is removed by taking the ring in the hand and quickly rotating over so as to throw the model out, distal part first. The matrix is examined, and if found perfect is ready to receive the molten metal.

348. Babbitt metal is most commonly used for this purpose, since in cooling less contraction occurs than when zinc is used. The latter, however, is preferred by many, because of its contraction in cooling, the claim being made that this contraction compensates for the expansion of the plaster model. If the contraction occurred without distortion, zinc would certainly be the best metal to use, but this is an impossibility, so

it is preferable to use a metal that will copy accurately the model, and then compensate for expansion, as outlined in Chapter 3.

In laboratory practice, before beginning to form the sand matrix, the metal should be placed in a suitable ladle and set over the flame to heat. Usually, by the time the matrix is formed, the metal is melted and ready to pour.

349. In order to secure a smooth surface to the die it should not be overheated, but be just plastic enough to copy accurately the surfaces against which it is cast. The proper

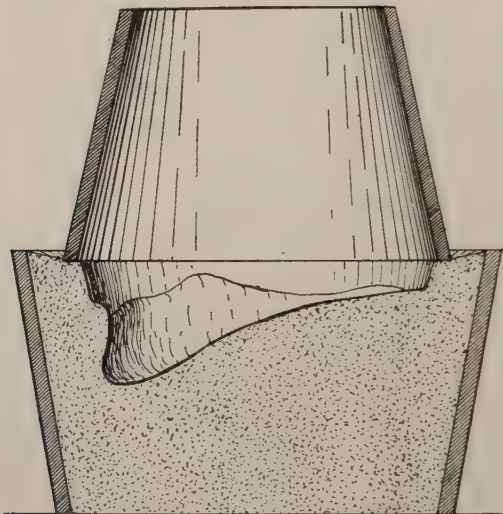


FIG. 125.

temperature for use may be ascertained by stirring with a soft pine stick while in the ladle. As soon as it ceases to char the stick it may be poured with comparative certainty of success.

Casting the Die.

350. When ready to cast, the ladle should be brought down close to the ring so that the metal, in running into the matrix, may not fall any distance and thereby distort the sand. Usually it is best to pour it into the back part and allow the metal to run forward around to the opposite side and up level with the upper margin of matrix. A smaller ring corresponding

in size to the peripheral outline of the model is quickly set upon the sand, centered evenly over the matrix and pressed slightly to prevent the escape of the metal between the lower margin of the ring and the sand (Fig 125). The remaining portion of metal in the ladle is now poured upon the first, and if the steps have been quickly and properly carried out the two bodies of metal will unite, thus forming a deep and compact die capable of resisting the blows of the hammer, to which it will be subject in swaging, without fracture. When crystallized the die is knocked out of the rings, chilled and prepared for casting the counter-die.

Casting the Counter-die.

351. The die is invested in the large ring, face up, and surrounded with sand, packed solidly against it to hold it firmly in position.

All that surface of the die which is to be covered by the

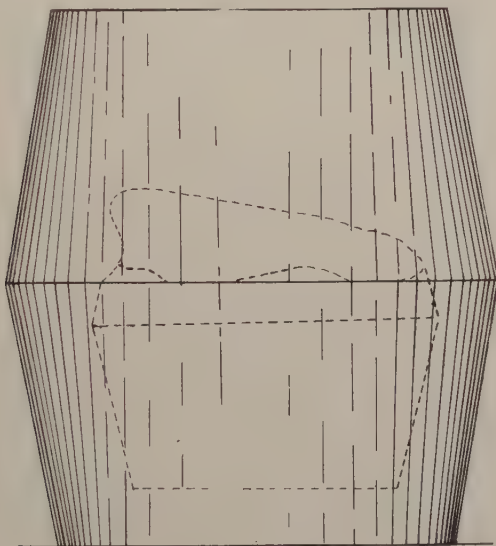


FIG. 126.

plate is left exposed; the remaining portions are covered with the sand. The upper surface of the sand should be practically horizontal and even with the upper margin of the ring. The surface of the exposed metal is covered with a film of

whiting and gum Arabic with alcohol and allowed to dry. This prevents the union of the die with the counter-die metal. A second ring of the same size as the first is set in position upon it (Fig. 126) and the counter-die metal, composed of one part tin and seven of lead is melted and poured slowly upon the sand, gradually allowing it to cover the die to a depth of one to one and one-half centimeters. The same precautions in regard to pouring the die metal too hot are applicable to this metal as well, although for a different reason, for if poured too hot it will unite with the die metal regardless of the fact that its surface has been covered with whiting.

352. When the metal has cooled somewhat the rings are removed, the sand brushed off and the two are chilled and separated. If they do not part easily they should be placed upon the swaging block and struck a blow or two with the hammer, when, unless fused together, they will separate readily. If a core has been used and there is a decided depression in the die, this should be filled up with sand before casting the counter-die, or it will be difficult, if not impossible, to separate the two without mutilating them.

The die and counter-die having been secured, the next step is to cut the pattern for the plate.

Forming the Plate Pattern.

353. This may be secured by taking a sheet of tea lead somewhat larger than the plate is to be, oiling the die and counter-die and conforming the lead to the die, first with the fingers and afterward swaging into the counter-die. It is now removed from the die and trimmed to the general outline form of the plate, as indicated by the die, allowing from one to two millimeters surplus all around the entire periphery. After being trimmed to proper outline it is carefully flattened out, without stretching or tearing, laid on a piece of cardboard, and a pattern of the exact size cut of this material, from which to order the plate. Number 60 tinfoil is often used instead of tea lead, and even tough paper might be substituted in case neither of the materials are at hand.

The forming of the pattern should be carefully carried out, as only a slight surplus around the periphery of a gold or platinum plate increases the cost very considerably.

Gauge and Karat of Plate Used.

354. Full upper and lower dentures should, as a general rule, be constructed of 20-karat gold, twenty-eight gauge. Twenty-two-karat gold is too soft to withstand the stress of mastication, while 18-karat is too stiff to be readily conformed to the die, and in some mouths gold of this grade frequently discolours.

355. In partial cases, plates are often constructed of two thicknesses of gold plate, the one next to the alveolar border being of thirty or thirty-one gauge, the second one of twenty-nine gauge. When the lingual surface is very irregular and



FIG. 127.

rugæ prominent, a piece of 22, or even 24-karat may be placed next to this surface, because of the ease with which it can be conformed and the perfect adaptation which can be secured. Over this must be placed the second piece of thicker and lower karat plate, in order that the required stiffness may be obtained.

356. Platinum plate, used as a base for continuous gum dentures, should in most cases be of twenty-eight gauge, and in addition be stiffened by a secondary strip of metal extending across the distal margin of the plate.

Fig. 127 represents a gauge plate used for measuring the various thicknesses of gold plate and wire of various sizes.

Swaging the Plate.

357. Before beginning to swage gold plate, it should be thoroughly annealed, in order to reduce it to the softest possible condition. This can best be done by laying it on a charcoal or asbestos soldering block (see Fig. 128) and applying the large, soft flame of the blowpipe, until it is brought to a cherry red heat, and then quickly throwing it in cold water or alcohol.

358. The die and counter-die should be thoroughly oiled, for two purposes, first, to permit the gold, during the swaging process, to slide over the surfaces of the die and counter, and thus prevent tearing, and second, to obviate, as far as possible, the contamination of the gold with the baser metals. This

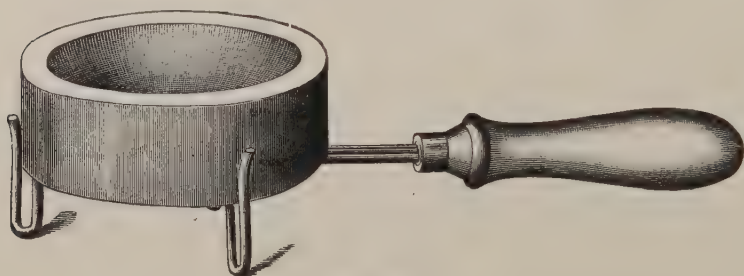


FIG. 128.

does not obviate it altogether, but it is prevented to a considerable extent by the presence of the oil.

359. The gold is placed over the face of the die and conformed somewhat with the fingers by pressure. The large end of the horn mallet is used to draw the palatine portion down somewhat into place. The thumb can then be placed in this portion of the plate and the outer margins partially conformed to the die. It is then placed between the die and counter-die and the former tapped a few times very lightly with the hammer. The plate should then be examined and if any wrinkles have begun to form they should be removed with a pair of flat nose pliers, the plate pickled, polished with a stiff brush wheel and pumice stone on the lathe until perfectly free from all base metal and then again annealed.

360. The swaging and annealing process should be repeated as often as necessary until a perfect adaptation of plate

to die is secured. During the swaging process the surplus margins are trimmed away with the plate shears and the base given its proper outline. It is best to leave these margins too full rather than trim away more than will be required, since in fitting the plate to the mouth the surplus, if there is any, can be cut away at this time.

361. When the swaging is completed the plate should be pickled in 25 to 50 per cent solution of sulphuric acid, to remove any discoloration that may be present. Pickling in sulphuric acid will not remove the base metals, since this acid is not a ready solvent of them.

The cleaning of the metal is accomplished by polishing the plate with pumice stone and a stiff brush wheel on the lathe. This should be thoroughly carried out before annealing or attempting to solder any attachments to the plate. If any base metal be present, under the heat of the blowpipe, it immediately unites with the gold, forming a low alloy, which melts at a lower temperature than the solder, and the plate itself frequently fuses before the solder flows.

Fitting the Plate.

362. The plate, when polished, is ready for fitting in the mouth. The sharp edges left in trimming with the shears must be removed with the file and the peripheral margin smoothed so as not to injure the tissues. It is then introduced into the mouth and pressed to place. If the buccal muscles or labial frænum, when contracted, displace it, the margins should be trimmed at such points to relieve the pressure.

"Taking the Bite."

363. This step is similar in every respect to the details already mentioned in Chapter 6, paragraph 138, where ideal base-plate is used, and a wax rim is built upon it. The gold base-plate takes the place of the base-plate proper and the directions there given apply with equal force to the case under consideration.

Locating the Wire Line.

364. In full gold dentures the teeth are attached to the base with vulcanite. In order that the line of junction of this with the base may be uniform, a fine wire, usually of 19 gauge

and 20 carat, is soldered to the plate on both lingual and buccal surfaces (Fig. 129*a*). This wire is finished with burs and stones, so as to present a square shoulder against which the vulcanite is finished (see *b*).

365. The wire is located on the lingual surface at such point that no angle is formed by the vulcanite meeting the plate. This line is determined in waxing the case after the teeth are occluded, the wax being carried down sufficiently far to produce a graceful curve corresponding to the general curve of the palatine arch (see *c*). The plate at the lingual



FIG. 129.

termination of the wax is scratched with a sharp instrument to indicate the wire line.

366. The wire on the buccal and labial surfaces is usually located from one to two mm. from the peripheral margin of the plate, and this, also, is dressed so as to present a square shoulder to the vulcanite. The surface of the wire opposite the vulcanite is cut away so as to meet the plate in a symmetrical curve, thus obliterating any angle into which food might find its way.

Soldering the Wire.

367. The teeth and wax are now removed, the plate taken from the model on the occluding frame, one end of the wire placed in position, usually at the distal part of the plate, and held in place with a clamp.

A small piece of solder is laid against the wire and fused with the blowpipe. The clamp is then removed and the wire conformed to the line marked upon the plate, the clamp again set and that portion which is correctly conformed is soldered. It is useless to attempt to adjust the wire all around before beginning to solder, as it will most certainly become displaced and perhaps attached incorrectly.

368. Several spurs of wire or narrow pieces of plate should also be soldered to the ridge at this time, to afford anchorage for the vulcanite. These should be so located as not to interfere with the ridge lap or pins of the teeth and consequently must be set a little to the lingual. The wires having been attached, the plate is returned to the die and a diamond point engraving tool used to raise barbs all over the entire surface that is to be covered by the vulcanite. These, in addition to the spurs already soldered on, will be sufficient to hold the vulcanite firmly in place, when once molded around them. The wires are now finished up, squaring the inner surface and beveling the outer, as before indicated, the wax and teeth returned to place and correctly adjusted, when the case is ready for investment. From this point on the steps are similar in most respects to those of vulcanite work.

Partial Dentures.

369. Since dentures of this class are frequently constructed with clasps, it will be necessary to describe the construction of these appliances before outlining that of the plate.

Clasps.

Clasps are small, partial band appliances which are made to conform to and accurately grasp some of the natural teeth, or crowns fitted to natural roots. These appliances, when attached to a partial denture in suitable position and numbers, retain it firmly in place. Objections have been urged against the use of clasps, the principal one of which is that by affording lodgment for food, the teeth which they encircle readily decay. This objection is not valid when the teeth and denture are given the care and attention that ordinary hygienic conditions demand, while the comfort afforded the wearer, where these appliances are indicated, more than compensates for any danger that might arise along the lines indicated.

Most Suitable Teeth for Claspings.

370. A tooth with as nearly parallel sides as possible should be selected for claspings, provided it is in the right location.

The second bicuspid, owing to its location and form, is perhaps the most suitable tooth for claspings, the first bicuspid is next the most favorable, and the first molar ranks third.

This is not given as an absolute rule, for these teeth are sometimes so shaped as to render them unfit for clasping purposes, while other teeth not mentioned will frequently carry clasps to good advantage.

371. Clasps should not be set at the distal termination of a plate when a suitable tooth anterior to this may be made to receive it. There will be less liability of the plate tipping



FIG. 130.

under stress if the clasps can be set about midway between the median line and the distal termination of the denture.

When possible to so adjust them, better results can be secured by placing the clasps so that the open side of one is presented forward and the opening in the other backward. (Fig. 130, *a b*.)

Construction of Clasps.

372. The teeth to be clasped having been decided upon, an accurate plaster impression is taken of them. A convenient way of doing this is to bend a piece of pasteboard in the form indicated in Fig. 131 and use this as an impression tray. It is filled with plaster and carried well up on the tooth, so as to secure an accurate impression of the entire tooth and cervical portion of the gums. When set, the impression is broken through the middle (Fig. 132), the tray readily permitting this to be done, removed, placed together again and wired in position.

373. Should there be a proximating tooth, and it is not

desirable to reproduce it on the die, the impression may be filled up with moldine. A strip of moldine is built around the margin of the impression to increase its depth and give a heavier body to the metal die. Melotte's metal is melted and poured directly into the die. This can be done immediately without drying out, since the steam can readily escape through the sides of the impression. The impression is now removed and a heavy tinfoil pattern cut for a pattern of the clasp.

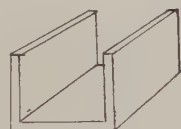


FIG. 131.

374. A piece of plate of length and width corresponding to the pattern is cut from clasp metal (20 parts pure gold, 2 parts platinum, 1 part silver and 1 of copper) of 26, 24 or 22 gauge, depending on the length of the tooth to be clasped. Long teeth do not require as thick metal for clasps as very short ones, for reasons that are obvious. The clasp should encircle at least two-thirds of the tooth, and should be from

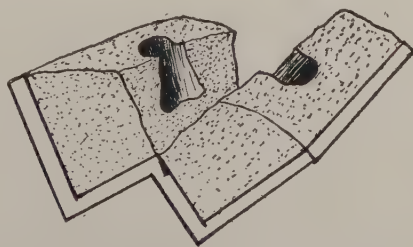


FIG. 132.

two to four mm. wide, depending, as before stated, on the length of tooth to be clasped.

375. Begin the adaptation of the clasp at one end, close to the inter-proximate space, and adapt with the pliers (hawk-bill and round-nosed), using the riveting hammer to secure a close and perfect adaptation as the work progresses. The cervical end should be trimmed to a line parallel with the gingivæ, the occlusal end to a corresponding curve. The ends

should be rounded somewhat and the cervical and occlusal margins of the clasp beveled at the expense of the outer surface so as to destroy these angles.

Construction of Partial Dentures.

376. The preparation of the model for this class of denture has already been given. The construction of the die and counter-die differs in no essential way from those for full cases, so we will proceed to the swaging of the plate.

The thinnest metal is placed on the die and conformed to it, first with the fingers, then with the horn mallet, and afterward swaged into the counter-die. A small steel chaser is used to drive the gold into the angle formed by the lingual surfaces of the teeth with the lingual gingival margin of the gums, carrying the metal into this angle perfectly. (Fig. 133.) This plate is then fitted to the plaster model, cutting away the surplus portions and giving the general outline form



FIG. 133.

to it. The gold should be allowed to reflect up against the lingual surfaces of the teeth from one to one and one-half mm. to afford a bearing for the plate against these surfaces. The second piece is now swaged, closely conforming it to the die.

Fig. 133 A shows a *plate bender* and *plate nipper*. The latter is very convenient for cutting out the plate around the teeth.

The plate bender is used for taking kinks out of plate and for forcing it into constricted parts of the die.

The two pieces should be annealed after pickling and polishing, the thin one returned to the die, the other placed over it, and the two swaged together. The surplus is not cut away from the second piece at this time, but allowed to remain until after the soldering is completed, since it forms a shelf on which the solder may rest during this operation. The plates should now be perfectly cleaned and polished on all surfaces, the two contact surfaces covered with a film of

borax and two or three clamps made of wire, sprung over the two to hold them in close contact while soldering.

377. The solder should be cut in medium-sized pieces and distributed around the entire margins of the plates. The case is now set on the block and the large, soft flame of the blow-pipe applied, being careful not to heat so rapidly as to displace the solder. When the plate is thoroughly heated the solder should be drawn in so as to fill the entire space between the two plates. Should there not be enough laid on the first time, more should be added until the entire union of the two plates is effected.

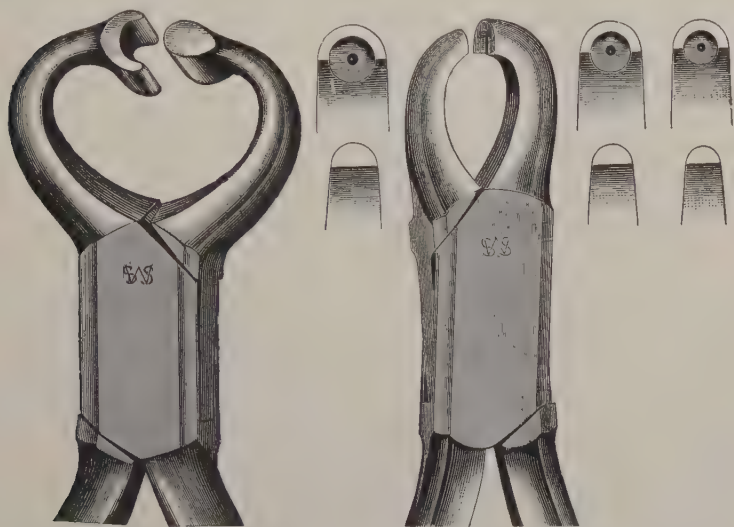


FIG. 133A.

After this is accomplished, the projecting portions of the plate last swaged are cut away to the outline already given the first piece. In carrying this out the plate should be returned to the model occasionally and the conditions noted so that too much material may not be cut away.

When trimmed, it is ready to try in the mouth. If it is a clasp plate the clasps are fitted to the proper teeth and the plate filed away sufficiently to pass into position without disturbing them.

378. Contact, however, is necessary between plate and clasps, but it should not be obtained at the expense of displac-

ing or springing either the appliances or the metal base. Fig. 134 shows the relation of clasps, plate and teeth to each other. When properly fitted an impression of the clasp, the tooth bearing it and the plate is taken in plaster, and when set, removed. If the clasps and plate do not come away with the impression they should be removed, placed back in it, the plate waxed at some point to hold it firmly in place, and the clasps set in their respective matrices.

379. Since these appliances have a tendency to spring together when removed from the teeth, they should be wedged apart by inserting a small piece of wood across the long diameter and thus force the clasp against the matrix walls. (Fig. 135*a*.) The piece of wood should not be more than one or two mm. in diameter and a trifle longer than the long diameter of the clasp in its contracted condition. The impression is filled with investing compound, being especially



FIG. 134.

careful to flow it down into the impressions of the teeth carrying the clasps.

380. When set, the impression is removed, borax and solder is placed in contact with plate and clasp and the two are attached together. It is unnecessary, and, in fact, decidedly objectionable, to attach the clasp to the plate in soldering, to such an extent as to destroy its spring or clasping property. This occurs when the solder is allowed to flow along the joint between clasp and plate for a considerable distance, thus converting the clasp into an immovable ring or band. When so soldered it is sometimes a difficult matter to introduce the plate in and remove it from position in the mouth.

The attachment of solder should not be more than two or three mm. wide and should be made at the extreme end, *a*, or directly in the middle of the clasp when possible, *b*.

381. The clasps having been soldered, the plate is again fitted in the mouth and a beeswax or modeling compound bite and an impression taken. The case is then mounted on the

occluding frame in the usual manner of any partial case. Teeth are selected and ground to place. In these cases they are sometimes attached to plate by soldering and again by vulcanite attachment. When the former method is followed the teeth are first ground to place and then backed with 20-karat, 28-gauge plate.

382. Frequently over this a second backing is burnished to give the first additional support. As a rule the backings should be attached to the teeth previous to, or independent of, their attachment to the base plate. When the teeth have all been backed and properly trimmed they are waxed to the



FIG. 135.

plate and the latter removed and invested for soldering. The teeth should be protected from the blowpipe flame as far as practicable and only enough solder used to insure a firm attachment of backing to plate.

383. When the teeth are to be attached to the plate with vulcanite they are first waxed in position and the proper lingual contour given the wax, terminating it in such manner as to form no angles and yet not feel bulky to the tongue. The line of termination is now indicated, as before, by scratching the plate with a sharp instrument at this point. The teeth are removed, the plate taken from the model and the wires for

forming the shoulder against which the vulcanite is to be finished are soldered in place. Loops for attachment are also soldered on at this time. From this on the case is carried forward the same as the full denture.

384. The outline just given represents the class of partial cases most frequently met with, and which are, perhaps, the easiest to construct. Variations from these cases, however, frequently present themselves, some of which, owing to the position of the teeth, of the forms of the spaces to be filled, and the relation of the opposite teeth to these spaces, render the construction of partial dentures an extremely difficult matter. If one understands the fundamental principles of denture construction, and has made a close study of occlusion, they can, in most cases, devise ways and means of overcoming the difficulties as they are presented.

CHAPTER XV.

Construction of Porcelain-faced Crowns.

385. When the crown of a natural tooth has been lost, through caries or by accident, or when the tooth is to be used as an abutment or pier for a bridge, a device called a "crown" is constructed to fill the requirements of the case. This should conform as nearly as possible in appearance with the remaining natural teeth, as far as color, form, etc., are concerned, and should also restore the functions of mastication.

The Porcelain-faced Crown.

386. This crown consists essentially of a protecting cap fitted to the end of the root which is to carry it, of a pin or post, extending into the root canal, and upon which the retention of the crown principally depends, and of a porcelain facing, backed with gold, which is attached to the cap and pin by the solder, which forms the lingual contour of the crown. In the construction of this substitute the first steps which demand attention are the proper treatment and filling of the root canal, the facing of the end of the root and the removal of all portions of overhanging enamel and dentine which would prevent an accurate fit of band to root at its termination under the free margin of the gum. The first of these considerations, viz., the treatment and filling of the root canal, it will be taken for granted has been properly accomplished. This, however, might be said, that under no circumstances should the reaming out of the canal for the reception of the post be done until the permanent root-filling is in place, because of the danger of infection.

The second step, facing the end of the root, will now be taken up.

Root Preparation.

Facing the End of the Root.

387. When a considerable portion of the natural crown remains it may be removed by the use of small drills and fis-

sure burrs. The drill is first used, several holes being cut through the remaining portion of crown at right angles to long axis of tooth and from one and one-half to three mm. from the free margin of the gum. (Fig. 136a.) The crown will usually break off without difficulty while using this instrument alone. Should it not, however, a small fissure burr can be inserted into one of the holes and that portion of tooth structure not already removed by the drill can easily be cut away.

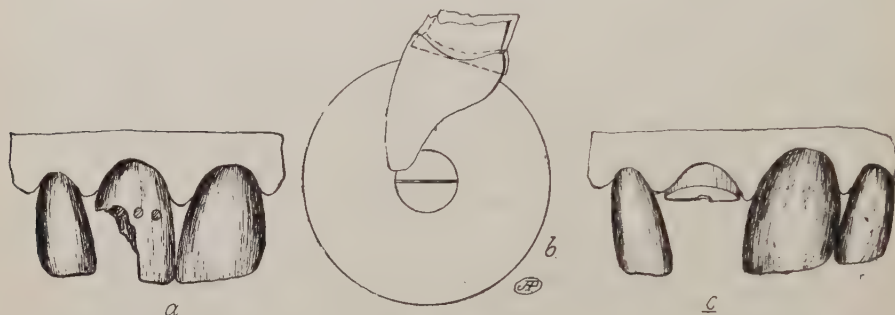


FIG. 136.

388. A moderately large-sized carborundum engine wheel is now used, and with this the root is faced, practically at right angles to the long axis of the tooth, *b*. The cutting at this time should not be carried under the free margin of the gum at any point, for the reason that in the subsequent removal of the enamel and in smoothing the peripheral outline of the root, more or less injury is inflicted on the soft tissues and the swelling and hemorrhage that occurs interferes with the proper fitting of the band if the root is shortened to its proper length at this time. Fig. 136c shows the first facing of root accomplished.

Removal of the Enamel.

389. The root of a single-root tooth may be said to represent a cone, the base of which is at the largest diameter of the crown, the apex at the foraminal end of the root.

390. In order that the band shall fit accurately and closely to the root at its termination under the free margin of the gum, it is necessary to so shape this portion of the root that it will also represent the section of a cone with its base located

well under the free margin of the gum, its apex directed incisally or occlusally.

391. Fig. 137 *a* and *b* shows the principle involved. It therefore follows that in many cases not only must the enamel

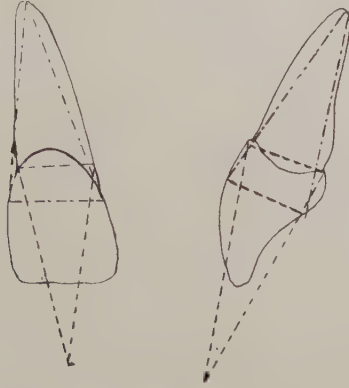


FIG. 137.

be all removed, but a portion of the dentine as well. This is accomplished by the use of several special instruments, the principal ones of which are the Case cleavers and the Prothero root trimmers.

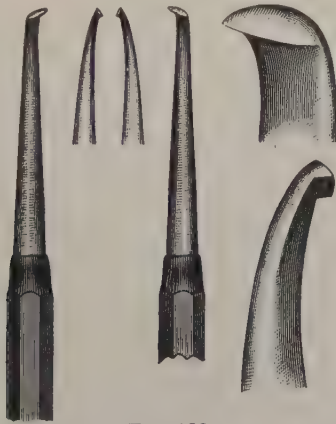


FIG. 138.

392. Fig. 138 shows the enamel cleavers, which are made moderately heavy and are tempered quite hard so as to readily fracture the enamel when applied with proper force, without losing their edge.

They should be used with the palm grasp while the thumb rests upon some of the proximating teeth as a support or rather as a fulcrum. The point is first placed against the enamel surface under the free margin of the gum, force applied and the instrument pulled away in the direction of the long axis of the root. (Fig. 139*a*.) It is then set close to the point of first application and this step repeated until the enamel around the entire periphery has been subjected to this procedure. This does not remove the enamel to any extent, but it is so fractured as to readily yield when the side blade of the cleaver is applied.

393. The side of the instrument is now used as a hoe, passing it up under the free margin of the gum as far as the enamel extends, *b*, applying the force as in the first steps and pulling it out with a sort of forward rotary motion. This loosens up

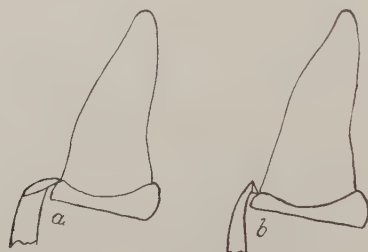


FIG. 139.

and brings away a little at a time the already fractured enamel ring around the periphery.

394. Sometimes it is difficult, owing to the limited interproximate space, to introduce the cleavers and remove the enamel from these points. One method that can be successfully used in some cases for opening up this space is to select the smallest fissure burr made, pass it into the interproximate space beneath the enamel, apply pressure so that the cutting may be done altogether at the expense of the root being prepared, and gradually work it through to the face end of the root.

If properly carried out no injury will be done the proximating teeth nor the tissues in these spaces. The cleavers can then be gradually worked into the space thus gained, using one from the labial side, the other from the lingual.

When the bulk of enamel has been removed the root trimmers (Fig. 140) designed by the author for this purpose can then be used for finishing up the case. These are handled in precisely the same manner as are the cleavers in the second step, with a forward rotary motion. The points of these instruments being thin, delicate and yet broad enough to afford sufficient strength to resist stress without bending, can be passed under the free margin of the gums without injury to the tissues. They can, in fact, be made to do the work of the fissure burr if properly handled. All of the remaining enamel and such portions of dentine as it may be found necessary to remove are cut away and the sides of the root smoothed uniformly. Bear in mind the conical shape it is necessary to give this portion of the root to insure a close-fitting band.

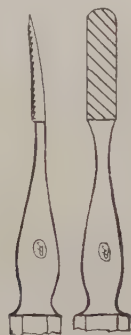


FIG. 140.

395. A good test as to whether the root is approaching its proper form may be made by placing the point of an explorer against the root and passing it upward along the side until it goes to or beyond the point where the band is expected to terminate.

Note, by comparing with proximating teeth, the direction in which the instrument travels. Place it on the opposite side and pass along side of root in same manner, comparing the direction taken by the instrument this time with that which it followed the first time. Should these lines converge as they approach the apex it indicates that the original cone shape of the root at this point has not been reversed, and more trimming is necessary. Should the lines diverge around the entire periphery the root is ready for measurement.

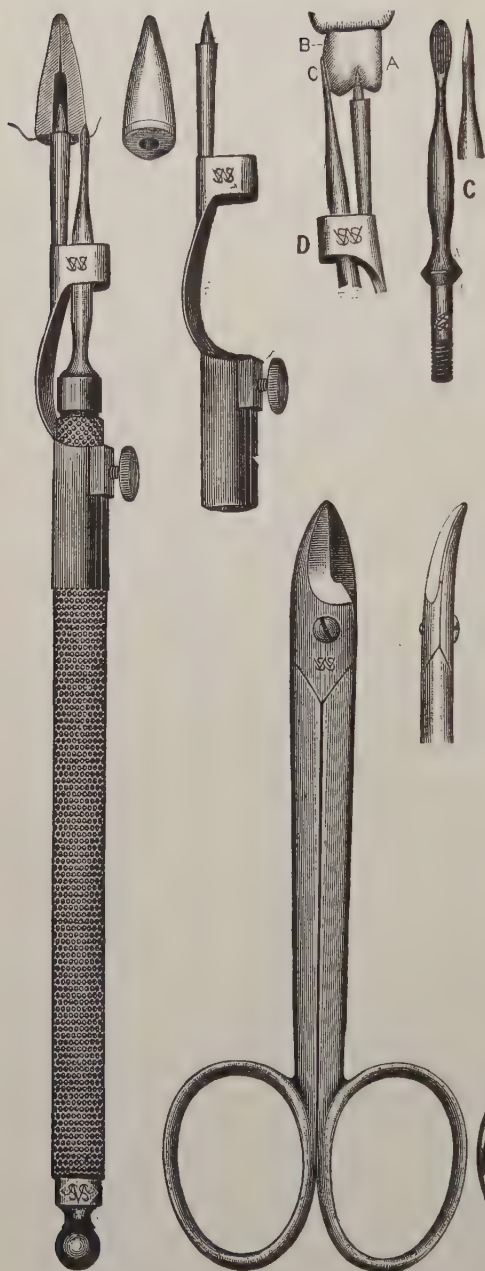


FIG. 141.

FIG. 142.

Taking Measurement of Root.

396. The most common and accurate method of taking the measurement of a root is with a fine annealed iron wire of probably 36 gauge. A short section 7 or 8 centimeters long is cut, bent in the form of a loop and placed in a pin vice, broach holder or dentimeter, and given a few turns to reduce the loop to nearly the size of the root. This loop is then placed over the root, and usually, with the aid of a delicate instrument, carried under the free margin of the gum on the lingual side (Fig. 143a). Pressure on the holder carries it to place on the labial

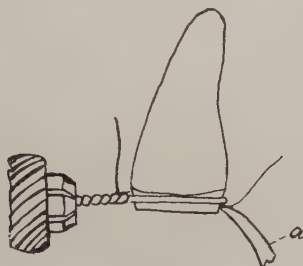


FIG. 143.

side. The handle is now turned and the loop tightened closely around the root. When this has been accomplished the wire is removed, cut opposite the twist and straightened out, being careful not to untwist the twisted portion.

397. If the wire measurement does not come away readily it indicates that the root has not been sufficiently reduced. This is the second, and usually an infallible, test as to root preparation. Should it be necessary to cut or untwist the wire to effect its removal, the root must again be reduced at such points as require cutting away, until the loop will come off without difficulty.

Constructing Band.

398. The wire measurement, when cut and straightened out, indicates the exact length the gold band should be cut. The width of band should be from 2 to 5 mm. wide, depending on the curve of gums at gingivæ and the convexity of the alveolar process in the interproximate space. The greater this curvature the wider the band must necessarily be.

The measurement is laid on a piece of gold plate 28 or 29

gauge, 22 karat, one end brought exactly even with the end of plate *a* (Fig. 144) and the other end *b* marked accurately with the sharp point of a knife. The width having been determined by examination, the strip of gold is cut as marked.



FIG. 144.

This is now annealed and bent in the form of a loop, the ends being brought together, so as to form a close-fitting butt joint.

399. In order to prevent the joint opening during the soldering process, a piece of fine untinned iron wire is made into a loop and twisted tightly around the outside of the band, the twist being placed opposite the joint. This serves as a handle for pliers while soldering. Many who are experts

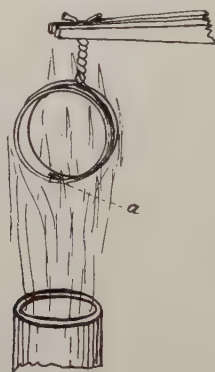


FIG. 145.

omit the use of the wire for holding the joint together, and solder without difficulty, the objection being urged against it is that the solder frequently unites the wire with the band. This is not a serious objection, for if care is taken in applying the borax no difficulty will be experienced along this line. The use of the wire is therefore recommended, at least until one becomes adept in handling solders.

400. A little borax paste is placed along the joint on the inner side of the band, covering each end slightly, but should

not be applied to the outer side. A small strip of solder about one-fourth mm. wide and from three-fourths to one mm. long, should be laid on the inside of the band and across the joint, the two ends of solder resting upon opposite sides of the joint (see Fig. 145a). An excessive amount of solder stiffens the band, so as to interfere with its correct adaptation to the root. With a pair of soldering pliers grasp the twisted loop of wire and carry the band close to the Bunsen flame, but not into it until the moisture has all been driven from the borax. As soon as this has evaporated carry the band into the flame and hold until the solder fuses. When this is accomplished remove instantly, as the gold itself is apt to fuse at the joint, if only slightly overheated. The wire is now removed and the band contoured the general shape of the root. Should the convexity of the border be marked, the band can now be cut out on mesial and distal sides and the margins smoothed up, when it is ready for conforming to the root.

Fitting Band to Root.

401. The band is placed over the end of root and pressure brought upon it to force it into position. Should it be a trifle small, as is often the case when the end of the root is considerably cone-shaped, it can be driven to place with a square end plugger in the automatic mallet. If the tissues fill the interproximate spaces and the labio- and linguo-gingival curves are well marked and deep, it may be necessary to *scribe* the band to place.

Scribing Band to Gingival Line.

402. This is done by setting the band up until in contact with the tissues in the interproximate space and then measuring the widest distance the band stands away from the cervical margin of the gum at any point (Fig. 146a). With this as a guide, mark a line on the gold, corresponding in curvature to that of the gingival line, and as far away from it as the gold is from gingival line, at point indicated (Fig. 146b). The band is then removed and cut along the line marked, the margins smoothed down with a file and it is again returned to the root for further adjustment. If this step has been properly carried out the margin of the gold will come exactly

in contact with the margin of gum at the same time, and when driven up to place will pass the same distance under it.

403. As a rule, a band should not pass more than one or one-half mm. under the free margin of gum except in rare cases. More failures come from the use of wide bands than from narrow ones, because of inflammation induced in the peridental membrane and soft tissues by the encroachment of

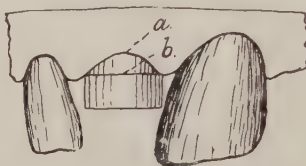


FIG. 146.

gold upon these tissues. The band having been driven to proper place, the cervical line or curvature of the gum is marked upon the gold (Fig. 147a), the band removed and cut to the line indicated. This finishes the incisal end of the band, which, when driven to position, should be invisible on the labial surface, but may be allowed to project slightly beyond the free margin of the gum on the lingual side of the root.

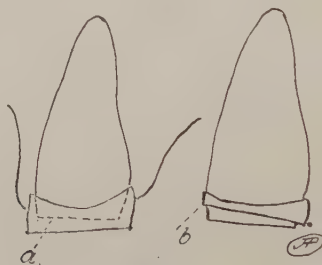


FIG. 147.

404. The band is now fitted in position again and the end of the root faced to correspond to the exposed end of the band. This is done with the large carborundum wheel in the engine. In grinding away the labial half of the root the stone should revolve from the center of the root to the periphery. If turned the other way the free margin of the gum would be caught over the angle of the root and lacerated.

405. The object in cutting the root down on the labial side

is to avoid any appearance of the metal when case is completed. This display may, in nearly every instance, be obviated if careful attention is given to this part of the work.

The root, having been ground, the band is removed and the cap constructed.

Construction of Cap.

406. A disc, or an oblong piece of gold a little larger in every way than the band, is cut and annealed, and the band is set upon it. With the fingers this piece of plate is conformed to the face end of the band and adapted so as to come in close contact with its entire circumference. When conformed, a film of borax is spread over the plate, the band replaced in proper position and a small piece of solder set so that one end rests upon the plate, the other against the band, as shown in Fig. 148, soldering it in the Bunsen flame.

The projecting portions are then trimmed away even with the sides of the band and the cap returned to the root for the insertion of the pin. This involves the reaming out of the root canal, a step that should be carefully carried out, on account of the danger of passing the burr through the side of the root.

Reaming Out the Root Canal.

407. This can best be accomplished with round burs of various sizes. The smallest round burr made (No. $\frac{1}{2}$) should

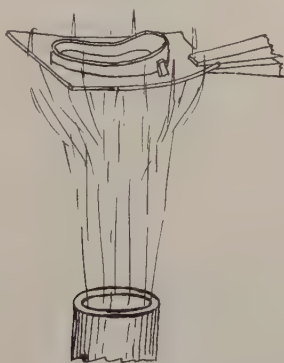


FIG. 148.

first be used. This is placed in the handpiece, the burr inserted in the canal and slight pressure made apically. Continued pressure should not be maintained, but as the canal

filling is torn up by the burr the latter should be removed frequently to draw out the cuttings. The handpiece should be held in the hand very lightly, the idea being to let the burr follow and keep in the canal, as it will do if no attempt is made to guide it, except to keep it pointing in the general direction of the apex. When the canal has been opened up as far as the post should be inserted, a larger sized burr of the same form is then used to enlarge the opening already made. This, in turn, is followed by a third one also round and large enough to allow the insertion of the 16-g. wire post.

Securing the Relation of Cap and Post.

408. The cap is now returned to the root and an opening made in the end with a drill, or, before replacing the cap, this hole may be punched with the plate punch. The opening should be made far enough lingually to permit the post to



FIG. 149.

extend beyond the face end of the cap into the solder, which forms the lingual contour of the crown, without in any way interfering with placing the facing in any position that may seem desirable. Should this hole, when punched, be so far to the lingual as not to coincide with the opening in the canal, the latter may be reamed out to conform to the opening in the cap.

The end of the post should be very slightly tapered, grasped in a pair of flat-nosed pliers and forced through the opening in the cap and into the root to the full depth of the enlarged canal.

409. A small piece of beeswax or modeling compound is warmed and pressed against the cap and pin, and, when hard, removed. If these pieces do not come away with the impression they should be removed and placed in it in proper relation. A little plaster is mixed, filled into the cap, built up the

length of the pin and allowed to set. Plaster is used because it sets quicker than investing material, and for this purpose answers every requirement.

410. The impression is now removed, a little borax placed around the pin, a piece of solder set against pin and allowed to rest on the cap, and the two soldered together (Fig. 149).

The cap, with pin attached, is cleaned and returned to the root for final impression.

Final Impression for Crown.

411. In most cases a modeling compound bite and impression combined will fulfill all the requirements in these cases. When this method is followed it should be carefully carried out.

For a single tooth a piece of modeling compound should be warmed and shaped in cubical form, the sides of which should be about one and one-half to two cm. each way (Fig.

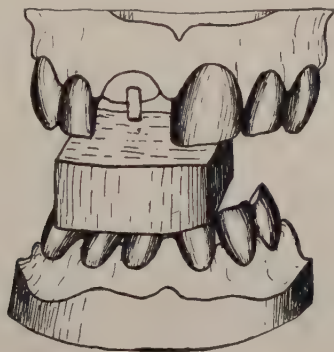


FIG. 150.

150). This cube is placed against the teeth so that, in entering, they will about evenly divide it into a labial and a lingual portion. When the teeth are closed the patient should be instructed to press the tongue against the compound so as to force it against *both upper and lower teeth*. This point must be impressed upon them, for, if instructed to *press against the teeth*, they will invariably force it all against the upper arch and palatine portion of the mouth. At the same time the operator should press the labial portion against these surfaces

of both upper and lower teeth, so as to secure an accurate impression of them.

412. A blast of cold air from the chip blower can be used to cool the material, and when hard the impression is removed.



FIG. 151.

The cap should then be set in position and a little wax melted outside of the band on the lingual surface to keep it in position while pouring the model (Fig. 151a). The models should now be constructed and mounted on the occluding frame.

Selection of Facing.

413. First, the facing should correspond in shape to the proximating tooth or teeth as nearly as possible. It should be broad enough at the cervical end to cover the cap, mesio-distally, since, if smaller, an unsightly shoulder will be formed that will impair the appearance of the finished crown.

414. Since the shade of thin porcelain is usually modified, to a greater or less extent, by the color of the metal backing, careful attention must be given in selecting facings.

When pure or 22-k. gold is used for backing, a yellowish tinge is imparted to the facing, and if the shade is already yellow it is deepened, to a greater or less extent, depending on the thinness, color and translucency of the porcelain.

Platinum, when used instead of gold, is apt to darken porcelain and impart a bluish tinge. English dentists use an alloy known as green gold (75 parts pure gold, 25 parts pure silver) to give the porcelain a greenish tinge when desired.

These three classes of backings can, therefore, be used to change the shade of the facing selected, should it not quite correspond to the natural teeth. It requires considerable care

and experience to match and select facings, which, when backed and soldered, will harmonize with the natural teeth. No explicit directions can be given on this subject, since the character of backing used, the thickness of the porcelain, its quality, translucency, etc., are all modifying factors. The best that may be said, however, is to select facings having as nearly the exact component colors of the natural teeth as possible. If any variation from the shade of these is made, it should be along the line of lighter colors only, since the tendency of the backing is to always darken the porcelain.

The facing having been selected, the next step will be to grind and fit it to the cap.

Grinding and Fitting Facings.

415. In constructing crowns, of the class under consideration, there is no necessity for grinding the porcelain so as to rest upon the end of the cap, to any extent, except at the ex-



FIG. 152.

treme labial margin. The ridge lap should be ground so as to leave a V-shape opening between the end of cap and porcelain, the only point of contact being, as before stated, at the extreme labial margin.

416. In most cases it is necessary to protect the incisal end of facing from stress by tipping it with gold. When this is done the linguo-incisal angle is beveled at a greater or less inclination, usually at an angle of 45 degrees.¹ Since this end, as well as the cervical portion of the facing, is tipped with gold, allowance must be made for this in grinding, and the facing correspondingly shortened. When grinding the cervical or incisal portion of a facing the stone should be placed so as to cut from labial face to lingual. When so held, the delicate margin of porcelain will not chip away, as would occur if the stone revolved in the opposite direction. (Fig. 152.)

Backing the Porcelain.

417. A piece of gold, a trifle wider and longer than the facing, is cut, and holes punched in it to receive the pins. The relation of these holes to each other is easily ascertained by flowing a film of wax over the backing and impressing the pins of the facing into it. The plate punch is set over the points indicated, and the holes punched accordingly. Before impress-



FIG. 153.

ing the wax care should be taken to see that the pins are parallel with each other. Another method of securing the relation of the holes to each other is to punch one hole in approximately the right position, insert one pin of the facing into it a short distance and rotate the facing around this pin. The other pin, acting as the circumscribing leg of a compass, marks a line on the gold (Fig. 153). This line indicates the nearest approach of the circumference of the opposite hole, which should be punched on this line in proper mesio-distal relation.

418. Several punches have been devised for this work. One of these, the Young punch (Fig. 154), consists of a plier-like

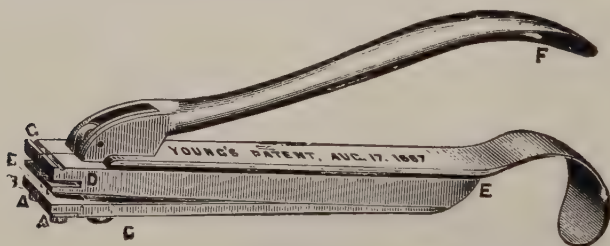


FIG. 154.

instrument having two adjustable, movable beaks attached to each handle. One set of beaks carry the steel pins for making the holes, while the others have holes exactly opposite for receiving the pins. The pins of the facing are dropped into the holes on the outer side of the adjustable beaks. This adjusts the beaks and at the same time holds them in proper relation to each other, the backing is then inserted into a slot designed

to receive it, and the holes punched, when they will be found to coincide exactly with the pins.

419. The backing should be annealed, the facing placed in position and the gold burnished against the porcelain. It is first conformed as far as possible with the fingers, then removed, annealed and returned to facing. The contra-angled burnisher is now used to more closely adapt it to the porcelain. It is again annealed and returned to the facing. A large cork



FIG. 155.

(Fig. 155) with a broad, shallow groove cut in it is used as a final means of securing a close and perfect adaptation.

The facing, with backing in place, is laid, pins down and pressed into the groove in the cork. A small piece of wood, ten or twelve cm. long, one end of which is reduced to a smaller area than the facing, and slightly depressed, is set on the labial face of the porcelain. With a two or three ounce hammer the stick is tapped, so as to drive the facing against

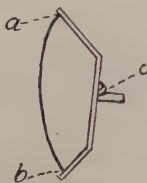


FIG. 156.

the cork. The gold, being interposed, is necessarily driven against the porcelain closely at every point, and thus a perfect adaptation is secured.

420. The facing is then removed and the surplus gold cut away with a file, even with the margins, on the mesial and distal surfaces, but not on the incisal or cervical ends. Along these margins the gold should be allowed to project slightly until after the soldering has been accomplished (Fig. 156*ab*).

If, in trimming away the surplus, the backing becomes distorted, it should be returned to the cork and again conformed to porcelain.

421. The backing is held in position against the facing by shaving spurs from the sides of the pins and bending them down so as to press upon the backing (*c*). This plan is much more satisfactory than bending the pins, since, in small facings



FIG. 157.

especially, the porcelain is often fractured by the strain put upon it while turning the pins down.

422. That portion of the gold over the ridge lap of the facing may be reduced to one-half its thickness or less, while the labial half or third of the cap may be similarly reduced (Fig. 157*ab*). This brings the porcelain close to the end of the root, it being removed from the latter by the interposition of less than one thickness of 28-gauge plate, and thus obviates the unnecessary display of metal.



FIG. 158.

423. The facing, with backing attached, is waxed in position on the cap, care being taken to set its cervical margin even with the labial face of cap, unless the case demands other arrangement (see Fig. 158). Previous to this final waxing the cap should be removed, the plaster cut out from the band, and the cap returned to position on the model. The waxing is then accomplished, as described, care being taken to melt it into

every point where it is expected the solder will flow, being especially careful to keep it off the porcelain. When waxed in proper relation and the wax has cooled, it is ready for investment.

Investment of Crown for Soldering.

424. Various investments may be used for this purpose, but as good as any is a mixture of one-third to one-half coarse ground asbestos with two-thirds to one-half plaster. The two should first be mixed dry and then the water added, in quantity sufficient to make a stiff mass. The cap is first filled perfectly full to prevent the ingress of solder during the subsequent steps. A small cube of the investment is then built on a slab and the crown pressed into it, so as to cover all the metal portions, leaving only the wax exposed. It is best to depress the crown in the investment, as indicated in Fig. 159, so that the lingual margin of band is on a horizontal plane



FIG. 159.

with the lingual, incisal end of facing. This is in order that the solder, when fused, in seeking its level, may assume the proper lingual contour.

425. The investment for ordinary crowns should be about two cm. deep, from one to one and one-half wide and a trifle longer than the crown is from incisal end of facing to apical end of pin.

426. When the investment has hardened it should be trimmed down to about the size mentioned, and the joint between the cap and backing entirely exposed without uncovering the porcelain. This can easily be done by placing the point of a knife on the backing and cutting away the investment above this surface along the margins of the facing, down to the ridge lap, and finally boring a hole through from side to side, so that the joint may be entirely open. When this has been properly carried out the wax is removed, first with an instrument and afterward with hot water.

427. The surfaces of metal to be covered by solder are first covered with a film of clean borax paste, and large pieces of solder, also covered with borax, are placed into the lingual V-shape space between cap and facing, enough being added to give proper lingual contour to crown when fused.

Soldering.

428. The investment is set over a Bunsen flame to dry out, and when the moisture has all been expelled the flame of the blow-pipe is directed around the base of the investment and under the porcelain to heat it up and allow it to expand before the flame is directed upon the pins.

Should the pins be heated first, the porcelain is very apt to check on account of the expansion occurring in the metal before that in the facing has taken place. When the solder has fused and settled down into the deeper parts of the crown the flame should be continued on its surface, for a moment or two, to keep it in a fused state and permit the borax in the interior to find its way out, or be drawn out by the heat. The confinement of the borax in the substance of the fused solder accounts for the presence of pits so often found here.

429. Care should be taken to see that the solder is drawn entirely through to the labial margin of the band, as the joint at this point, between it and the backing, should be entirely filled up. If enough solder is not applied at first to give proper lingual contour, more should be added until this surface is correctly developed.

After the soldering has been accomplished the investment, still holding the crown, is covered over with something to prevent the draft from striking it, or it may be thrown into plaster-of-Paris and allowed to slowly cool. When cold the crown is removed from the investment, pickled in acid and washed, when it is ready for final finishing.

Finishing.

430. The surplus margins of the backing are cut away with files or engine stones, in this case always cutting from the gold to the margins of the porcelain. (Fig. 160a.) This tends to force the gold into any little irregularity that may be present along the margin of the facing. The surplus having

been cut away, engine discs of gradually increasing degrees of fineness should be used to remove the scratches made by file or stone.

431. The margin of the band, which passes under the free margin of the gum, should be beveled to a feather-edge, at the expense of the outer side, so that no shoulder or rough margin may be present to irritate the soft tissues (Fig. 160. *Section b*). The final polish is secured by using a felt wheel and pumice stone, first following this with whiting, and finally with rouge or tripoli.

432. Should the facing have darkened to any considerable extent in soldering, it is probably due to the surface of the backing next to the porcelain having discolored.

This may be corrected by placing the crown in a test tube

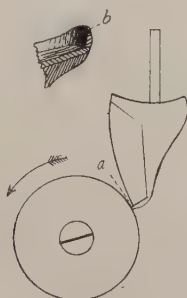


FIG. 160.

containing nitric or hydrochloric acid and boiling for a few minutes or for a sufficient length of time to permit the acid to penetrate the very constricted space between the porcelain and backing.

433. The crown, in form, fit and finish, should represent the highest attainment of human skill, and the prosthetist should be satisfied with nothing short of perfection. If he fulfills his duties in this respect the patient will be not only satisfied but appreciative as well.

Cementation.

434. A pellet of absorbent cotton should be placed under the lip to hold it away from the root and the canal wiped dry with some cotton, which is wound on a broach. The canal may be still further freed from moisture with the hot-air syringe.

The face end of the root and free margin of the gum should be wiped dry with a pellet of cotton. The cement is now mixed to a medium consistency and carried into the canal with the root-canal plugger. If the canal is perfectly filled with the cement there will be sufficient surplus expelled from it, when the pin is forced into place, to fill any space that may exist between cope and face end of root. Usually some of it is forced out between the periphery of root and band, and when set, an instrument should be passed under the free margin of the gum to remove it. Not a particle should be allowed to remain or periodontal trouble, which might result seriously, may be induced.

435. When the surplus has all been removed a fine stream of water, as hot as the patient can bear it, should be directed against the gums, over the root and around the free margin, and the gums afterward kneaded to restore circulation and to relieve the pain that is nearly always incident to setting any crown. The patient should be instructed to be careful and not subject the crown to severe usage for some little time, until the cement has had time to thoroughly set.

CHAPTER XVI.

Construction of Shell Crowns.

436. This crown consists, essentially, of a band, accurately fitted to the cervix of a tooth and extending from this point occlusally, to form the axial surfaces of the crown, while the occlusal surface is made by swaging a second piece of metal into the forms of cusps and attaching this to the band by soldering.

437. There are various systems for constructing these crowns, but at this time only one method will be given in detail. Substitutes of this class are, more particularly, adapted to the restorations of the crowns of bicuspid and molars and to serve as abutments and piers in bridge construction, for which purposes they are practically indispensable.

The shell crown is, perhaps, the simplest and most easily constructed substitute of any in use to-day, yet, for that very reason, because it is simple, many slight the important details of construction, with the result that their productions more nearly resemble a cartridge than the beautifully developed and gracefully contoured surfaces of a natural tooth.

The first step in the construction of a crown of this class will be the preparation of the root.

Preparation of Roots or Teeth for Shell Crowns.

438. The general principles outlined in the previous lecture, of converting the remaining portion of the natural crown into a cone, the base of which is under the free margin of the gum, at the point of termination of the band, the apex pointing occlusally or incisally, is also applicable to these cases. The crown is not faced down as close to the gum margin as for banded, porcelain-faced crowns, since the shell crown, being hollow, will receive a considerable portion of the natural tooth. The occlusal surface is reduced sufficiently to allow a thick cusp to be interposed between the prepared tooth and the occlusal surfaces of those opposite.

439. Should the tooth be badly or only slightly decayed, the carious dentin should be removed, a matrix placed in position and an amalgam filling inserted. This is necessary to afford a good anchorage for the crown and also to facilitate the preparation of tooth and fitting of band.

If the entire crown is decayed and lost, the root canals, after treatment and filling, should be reamed out and How posts or good strong pins of some sort inserted and cemented into them. The projecting ends should approach near the occlusal surfaces of the opposite teeth. The matrix, usually of thin copper, and soldered, should be set in place and amalgam packed into it so as to restore the crown in cylindrical form in metal. The matrix should be allowed to remain in position until the amalgam has perfectly set. It may then be removed by setting a sharp 20 chisel diagonally across its edge

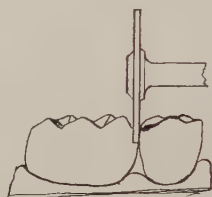


FIG. 161.

and tapping it a few blows with the mallet. The copper, being soft and thin, is easily cut. This is preferable to attempting to remove the matrix by slipping it off.

440. Perhaps the best points at which to begin the reduction of the old crown are on the mesial and distal surfaces. A thin rubber and corundum disc about 7 or 8 mm. in diameter in the engine mandrel can be used for cutting away these surfaces (Fig. 161). It is sometimes difficult to pass the disc down on the distal side, owing to the forward inclination which this tooth often assumes. A fine fissure burr, passed well into the interproximate space and carried upward and outward, will usually break away the enamel and give an entrance to the disc. Great care should be taken to keep the burr from coming in contact with the proximating tooth and cut only at the expense of the one being reduced. Be careful also to avoid the formation of shoulders at any point, but make the taper of these surfaces gradual and perfect.

The safe-sided files may, at times, be used to open up these spaces, as may also sandpaper discs.

441. The fissure burr can only be used in one interproximate space as a general rule, as the cutting must be done by moving the burr from gingival to occlusal surfaces. Fig. 162 illustrates the rotation of the burr in each space. In *a* the tendency of burr is to hug the tooth that is being cut, closely, while in *b* it would tend to cut the proximating tooth. By introducing the burr from the buccal while cutting out one surface, and from the lingual in cutting out the other one, they may both be opened with equal facility. This, however, is

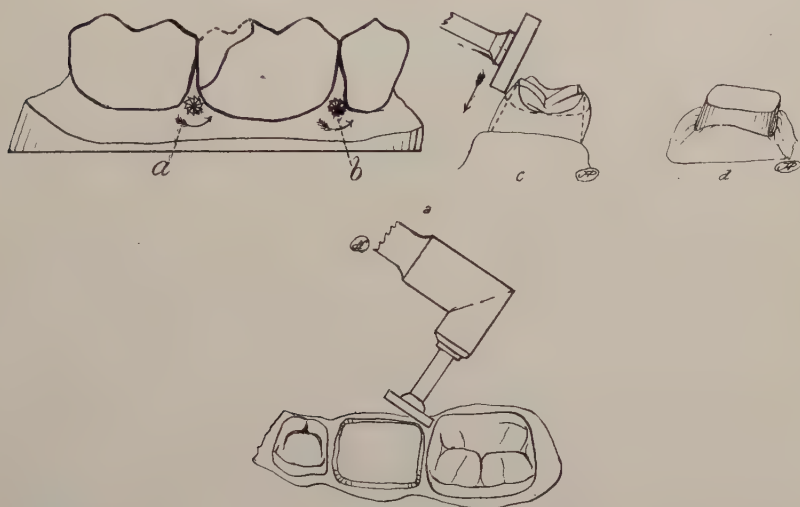


FIG. 162.

seldom practicable on account of the difficulty in controlling the hand piece from the lingual side. Fissure burrs in the right, or adjustable, angled hand piece can be made to do this work very efficiently.

442. The buccal and lingual sides are reduced by passing a carborundum wheel, held at a convenient angle, up and down, from occlusal to gingival lines, parallel with the long axis of tooth, continuing the cutting until these surfaces approach each other as they near the occlusal surface (*c*).

443. After the use of the stones and burrs, the tooth, when viewed occlusally, presents more or less of a rectangular form,

the four angles being rather prominent (*d*). As it is necessary to reduce these somewhat, it can be done with the small discs of rubber and corundum or carborundum, carried in the right angle mandrel (*e*). These discs, in this hand piece, will also remove the ring of enamel on the buccal and lingual surfaces that is left at and under the free margin of the gums while using the large stone in the straight hand piece. There is no "royal road" in this class of work. The only way to prepare the root properly is to know what is necessary to be done and then stick to it persistently, until it is accomplished, using any instrument that can be used to the best advantage.

444. Cleavers are of but little value here, since, in order to use them efficiently, and with force, they must be handled with the thumb and palm grasp. The position of the molar teeth is frequently such that it is not possible to use the instruments in this manner, so we must depend on other means of reduction. The instruments named, with a steady hand, keen eye and a good, sharp intellect back of all, will accomplish the desired results. Do not be satisfied with anything less than absolute perfection in all your operations, and especially in the steps under consideration, for if imperfectly done the work will be a failure. This part of the operation is the vital point, the weak link in the chain, in crown work. Strive to master the difficulties here and success will most assuredly follow.

The peculiarities of forms and positions of the teeth render it impossible to give explicit directions in the preparations of roots for crowns. The skill, *the hand craft*, comes only with experience, and then only in proportion to the determination of the operator to acquire it. It is my opinion that in the whole field of prosthesis there is no other operation that is so often unskillfully performed as is this class under consideration.

Taking the Measurement of Root for Band.

445. This step is carried out as already outlined in the preceding lecture. The loop should be placed just under the free margin of the gum and twisted tightly around the root. If difficult to remove, it indicates imperfect preparation, and sufficient additional reduction should be made to allow the wire to come away easily. When removed it is cut and laid

on a piece of gold, usually 28 g., 22 k., and the length of the band marked.

446. The required width is secured by measuring from the deepest curve of the gingival line of the tooth being crowned to the tips of the cusps of the opposite teeth (Fig. 163). Should the dip of the gingival curve approach nearer the apex of the tooth on one side than the other, the measurement should be taken from that point, since the band must be correspondingly broad. The band is cut of a width corresponding to this measurement. It might appear, at first glance,

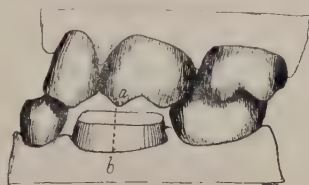


FIG. 163.

that when the band was festooned around its cervical margin to correspond to gum curvature, and driven under the free margin, it would be too short, but this is not the case. At most it would not be shortened more than one or one and one-half mm., and this amount of space is needed at the occlusal end in order to fit a thick, strong cusp on this margin.

Constructing the Band.

447. The band is cut according to the two measures just taken. It is then annealed, the ends bent together, the wire loop adjusted outside, borax and solder placed inside on the joint and the ends soldered in the Bunsen flame. A piece of solder one-half mm. wide and one mm. long is quite sufficient for the purpose.

Fitting Band to Root.

448. The band is now contoured to approximately the shape of the root, placed upon it and pressed down until the cervical margin just comes in contact with the gum at one point only. The widest space between band margin and gum is now taken as a guide and a line scribed on the band parallel with the free margin of the gum, this distance from it, all around the band periphery.

The band is then removed, cut to the line and the sharp margins around the outer side trimmed away with a file. It is then returned to the root and pressed down under the free margin of the gum the proper distance, usually about one or two mm., depending on the width of the gum flap at this point.

449. The mesial and distal surfaces should be forced out until perfect contact, at the proper contact points with the proximating teeth, is secured. The buccal surface should be contoured so as to present a perfect alignment with proximating teeth and the correct outline form should be given the occlusal periphery of the band at this time. When perfectly contoured the occlusal end should be dressed by laying on the flat side of a file and reducing until the periphery forms perfect contact when applied to a true plane. All of these points having been properly brought out and the band being in place, the next step will be to take the impression.

Taking the Impression.

450. This can usually be accurately secured with modeling compound. A small piece of this material is heated and shaped in the form of a cube about two centimeters square, each dimension, and placed over the band and adjoining teeth. The patient is then instructed to close the teeth together and exert pressure on the compound so as to *force it against both upper and lower teeth*. With the finger, the impression material on the outer side is forced against the buccal surfaces, so as to secure an accurate impression in this location. Cold air is then directed on the compound and, when sufficiently set, the impression is removed, being careful not to distort it any. The band, which usually remains with the tooth, is removed and placed in correct position in the impression.

Care should be taken to force it down to the exact position it occupied when in the impression in the mouth. If forced too far the completed crown will be too short, if not forced to place the crown will be too long.

Constructing and Mounting Models.

451. The side of the impression containing the band is filled in with plaster to proper depth and attached to the occluding frame, in the same position that a tooth of this class would occupy in a full case, when properly mounted. To

secure the best results in occlusion, these cases should be mounted on the lateral motion occluding frame.

The opposite side of the impression is then filled in and attached to the opposite bow. When set the compound is heated and removed from models.

Carving the Cusps.

452. The teeth opposite the band, and for a short distance in front and back of it, should be covered with separating medium. Plaster is mixed to a medium consistency and the band filled in, adding enough to insure a surplus. The opposite plaster teeth are now pressed into the freshly mixed plaster until the teeth on both bows of the occluding frame are in absolute contact. When set the two models are separated and the case is ready for carving.

453. It will be found that the plaster impressed by the opposite teeth, represents the reversed cusps of these teeth, and from this irregular surface must be developed, the cusps of the crown being constructed.

The plaster is trimmed from around the periphery of the band, removing it in such manner that the cut surfaces represent a uniform continuation of the band surfaces. A broad, shallow V-shaped cut is made in the occlusal surface, extending entirely through from mesial to distal margin of band. Since the lingual cusps of the opposite teeth have already produced a central groove, more or less plainly marked, this cut must necessarily be very shallow. The mesio-buccal, disto-buccal and lingual grooves are now laid in, in proper relation to each other, and the planes of the various cusps developed. Four or five points of contact of the occlusal surface with the opposite teeth is all that necessity requires and is as much as is found in the occlusion of natural teeth. The lateral motion should be given the frame to test the cusps in partial occlusion. If found too long they must be cut down to proper length, so that the completed crown will not require grinding at these points.

Casting the Counterdie.

454. The band with cusp in place is then cut or broken from the model, being careful to leave as much of a cervical matrix as possible in order that the band may be returned to

exact position again. The entire surface of gold is now painted with a coating of whiting and water, to which a little gum arabic solution has been added. The object of the latter is to act as a cement to prevent the whiting from being displaced, during the subsequent steps. Melotte's metal is placed in a deep ladle of small diameter, and melted. The crown is grasped in a pair of spring handled wire pliers, entirely immersed in the molten metal and held there until all moisture is driven off. This is indicated by the cessation of vibration, which occurs in the metal when crown is first introduced, and which is quite distinctly felt in both plier and ladle handles. When all moisture has escaped the crown is removed and imbedded in moldine up to the margin of band, leaving the cusps entirely exposed (Fig. 164a). The rubber ring is placed on

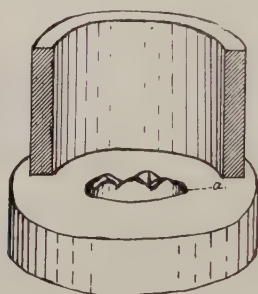


FIG. 164.

the clay and pressed against it until a tight joint is secured. The metal, which by this time is nearly cold, is poured slowly over the surface of cusps, and the entire molten ingot emptied into the ring.

When set, the counterdie is removed, and if the crown comes away with it, as is usually the case, the two are separated and the casting cooled. If perfect, the matrix and upper surface is oiled and it is ready for use.

Swaging the Cusp.

455. A piece of gold a little larger than the peripheral outline of the matrix is cut and annealed. A piece of soft pine about ten centimeters long is trimmed, at one end, to a size corresponding to matrix outline. The gold (Fig. 165) is then centered on the counterdie, the end of the stick applied

squarely in the center and struck a sharp blow with the hammer. This is repeated until the cusps are conformed in a general way to the interior of the matrix. The individual cusps are developed by using a piece of hickory, or some hard wood, the end of which is tapered to a moderately blunt point (Fig. 166). This is used in the same manner as the first

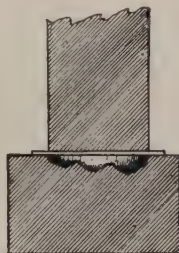


FIG. 165.

piece of wood, only the blows of the hammer should not be so sharp, as the idea is to *coax* the gold down into the deeper parts of the matrix rather than to attempt to force it down suddenly. If forced too rapidly it will most certainly be torn.

456. The essential points to be observed in swaging cusps are:

First: Oil the counterdie.

Second: Anneal the gold before beginning, and at intervals during the operation, if necessary.

Third: Force the gold down against the occlusal surfaces before conforming it to the walls of the counterdie.

Fourth: *Coax* the gold rather than attempt to *drive it forcibly* into the deeper parts of the matrix.

457. Before annealing, the gold should be thoroughly polished with pumice stone, to remove all base metal. If allowed to remain, it will form a low alloy with the gold, which, in the soldering, may fuse at the points thus contaminated. Do not under any circumstances neglect these precautions just outlined. Perfectly sharp, well-defined cusps can be produced if an effort is made to do so, providing the plaster pattern is properly carved. Those who are not familiar with the surface markings of the various teeth cannot hope to successfully reproduce them without some effort, and by comparison with

the forms of the natural teeth. No one could successfully draw from memory a map of one of the states or any country without having first studied it with reference to its proportions, outline form, location of prominent points of interest, etc. This is exactly what must be done in carving cusps. The surfaces of a natural tooth should be studied as a map, the outline form of the tooth fixed in the mind, the relation of the cusps to each other and their location with reference to the marginal ridges and central groove noted and many other points of interest observed. An effort should be made to reproduce the tooth in plaster, first with the model in view and afterward from memory. Persistent application along this line will develop the eye and hand in unison, until they work together harmoniously, so that after a time what the mind conceives the hand will execute. It is so in all of the arts and sciences. The secret of the success of some and the failure of

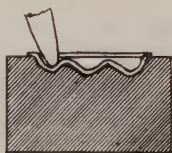


FIG. 166.

others depends upon their ability or inability to concentrate their attention and effort upon a given subject or manipulative detail long enough to master it.

Some have the natural ability to see and grasp things quickly. Others are slow of perception, and everything they do requires labored effort. Some never acquire speed, but any and all will improve if the effort is only made and continued persistently along right lines.

Fitting Cusp to Band.

458. The surplus margins are cut away with the shears and the gold cap dressed to the outline margin made by matrix. The plaster cusps should be removed and the band returned to its position on model. The swaged cap is now set on the occlusal end of the band and the frame closed to test the length of each individual cusp, as well as the correctness of their general relation to the opposite teeth.

As a rule the swaged cap will be too long, and, when set upon the band, will not allow the plaster teeth on the two models to come in contact. It should be filed down until this difficulty is corrected. The cusp should be placed on the flat side of the file and dressed to a true plane. You will remember, the occlusal end of the band was also dressed in the same manner. The two, when correctly fitted, will meet, forming a perfect joint, and one which will be easy to solder. Since the peripheral outline of the cap corresponds to that of the occlusal end of the band, the two margins will coincide exactly when fitted to proper occlusal length. When the fitting has been completed the two are ready to unite with solder.

Soldering Cusp to Band.

459. Clean, crystal borax should be ground with water, on a clean, ground glass slab, to the consistency of thick paste. The cap, having been polished with pumice stone, its interior



FIG. 167.

and joint margin is covered with a thin film of the borax paste and the band set in position. These two may be held together by wiring or with the Reese pliers (Fig. 167). Solder covered with borax is placed inside the band in sufficient quantity to not only solder the joint, but also to thicken the occlusal surface to three or four times that of the gold plate. This is to strengthen the cusps so as to withstand the wear and stress of mastication. The crown is now carried into the Bunsen flame and the solder fused. It is then pickled in 50 per cent acid (H_2SO_4) and is ready for polishing.

Finishing.

460. There will be but little surplus to cut away if the crown has been properly constructed, and this can readily be done with discs in the engine. A convenient method of holding the crown, while dressing down and polishing, is to trim

a stick of convenient length, so that it readily enters the cervical end of the crown. A little modeling compound is now heated and applied to the trimmed end, and while hot the crown is forced over it. It is then dipped in water to cool and the surplus trimmed away. When polished the crown is readily removed by warming. The polishing is accomplished in the same manner as described in porcelain-faced crown work. The occlusal surface can be finished best with a single row, stiff-bristle brush wheel, on which are used the various polishing powders.

The Saddle-back Tooth.

This tooth can be utilized in many ways, among the most important of which is in the construction of a banded porcelain crown for bicuspid. The accompanying cut shows the method



of application. The cap and pin are constructed and attached in the usual manner, the tooth ground, backed, waxed in position and invested. Solder is flowed in to fill the V-shaped space and the crown finished to proper contour.

CHAPTER XVII.

Construction of Banded Logan Crowns.

Fitting Plain Logan Crowns.

461. The Logan crown, as furnished by supply houses, consists of a tooth of porcelain, full contoured, in which a tapered pin of platinum is permanently attached. These crowns may

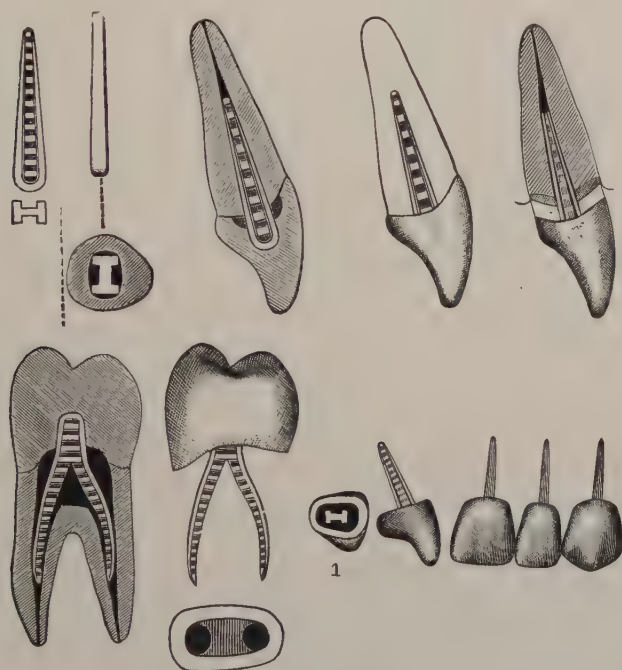


FIG. 168.

be set with or without bands, but as the root preparation varies in each system it will be necessary to describe each method separately.

Root Preparation for Banded Logan Crowns.

462. This differs in no essential particular from the methods given for preparation of roots for porcelain-faced crowns

for the anterior teeth, except that emphasis should be placed upon the facing of the root end, which should be practically at right angles to the long axis of root. It is in fact unnecessary to dwell upon this step or the construction of the cap, for the directions already given apply with equal force to the class of work under consideration.

Grinding Crown to Cap.

463. The cap having been fitted to root, an impression and bite in modeling compound are secured and filled, and the models mounted on the occluding frame. A crown of approximately the proper length and form is selected to fill the requirements. Its base or cervical end should be as large peripherally as the cap on which it is to rest, never smaller,



FIG. 169.

and if any variation from exact size occurs it must be larger. The porcelain can be reduced, but the cap cannot.

464. The position of the hole for pin is located by measuring from the labial or buccal cervical margin of porcelain to that surface of the pin and transferring the measurement to the cap, laying it off from labial or buccal side also. The width of pin can be ascertained and marked in the same manner. A narrow slot is now cut between the points marked, of approximately the same diameter as the mesio-distal thickness of the pin. The fitting of crown to cap can be best accomplished in the mouth, the steps being as follows: The hole for pin having been punched, the canal is reamed out labio-lingually with a fissure burr, to about the same diameter as the mesio-distal thickness of the pin.

465. It is an incorrect procedure to use a round burr or

even a taper reamer for enlarging canals to receive the large taper Logan pin, because of the weakening of root on mesial and distal sides by the unnecessary cutting away of tooth structure at these points. The small round burr must, of course, be used for removing the canal filling. The crown is then tried in position, the points of contact noted, and cut away

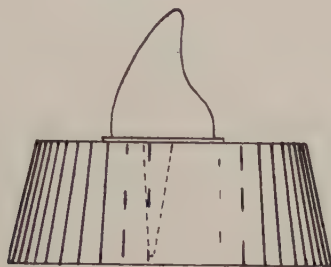


FIG. 170.

with carborundum wheels. The lingual surface of the joint should be opened up to present a decided V-shaped opening, as indicated in Fig. 122. There should be contact of the porcelain with the cap at one point only, on the extreme labial or buccal surface. If care is exercised in the selection of the crown and one of correct length obtained, but little difficulty will be met with in fitting to cap.



FIG. 171.

466. If the incisal or occlusal end is of correct outline to conform to occlusal conditions, and also correspond with the proximating teeth, whatever reduction in length that it may be necessary to make should be done by grinding the cervical end. As a rule, however, the incisal and occlusal ends of these

crowns need more or less modification, so that usually the crown is fitted by grinding away both ends, as indicated.

467. When reduced to correct length a disc of gold, 29 or 30 g., 22 or 24 k., is perforated with a hole for receiving the pin and burnished closely to the porcelain. The cork method before outlined may be used to good advantage here (Fig. 170). The disc should be allowed to project slightly all around the periphery of the porcelain to insure a perfect joint when soldered. The surface of gold at the point of contact of crown with cap (Fig. 171) should be reduced to one-half its original thickness, as should also the end of cap at same point, for reasons given in the previous chapter on porcelain-faced crowns. The disc having been adjusted, the crown is returned to root for final verification, and, if found correct, is ready to wax to cap.

Securing Relation Between Crown and Cap.

468. The crown is removed and dried, and around the pin is placed a little sticky wax. The end of the cap is also dried, the sticky wax around pin softened and the crown is forced up into correct position. The parts should be guarded from the saliva until the wax is sufficiently cool to enable them to be removed without distorting the relation they now sustain to each other. A small 6-2-23 hoe is a useful instrument for catching over the upper margin of the band and loosening the cap. If the removal is accomplished without the relation of the three pieces being disturbed, the case is ready for investment.

Investment.

469. The surplus wax is cut away from the margins of the cap, and any slight crack between this part and the disc filled in to prevent the ingress of the more fluid parts of the investment. The usual investment, coarse ground asbestos and plaster, is used in this case also. A mix is made and built up on a glass slab or a piece of paper laid on a flat surface. The band should be perfectly filled with investment and the crown then pressed down into the mass. There should be at least one to one and one-half centimeters thickness of investment between the crown and slab, so that when the trimming has been accomplished this body of investment may be sufficiently

strong to hold the parts in correct relation to each other during the process of soldering.

When set, the surplus investing material is trimmed away in exactly the same manner as described in the lecture on porcelain crowns, the wax perfectly removed and the case prepared for soldering.

Soldering.

470. In trimming away the investment, care should be taken not to expose any of the porcelain. There is frequently a tendency, while soldering, of the disc to draw away from the base of the crown. This may be obviated by cutting a wedge-shaped piece of plate and fitting it between disc and cap (Fig. 172a). The borax is carried into all parts of the V-shaped opening, sufficient solder to fill this is introduced, and the case set on the Bunsen flame to dry out.

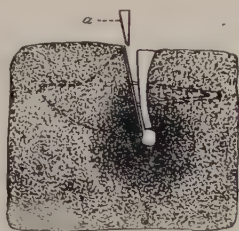


FIG. 172.

471. When heated up, the blowpipe flame is directed around the base of the investment and against the end in which the porcelain is inclosed, until these parts are of a bright red color. The flame may then be applied to the solder and this fused and flowed until it entirely fills the joint. Continue the flame for a moment or two in order to draw the borax to the surface. It is expected that the V-shaped space will be entirely filled with solder, and the contour of the crown, at this point, formed in this manner. When the soldering is completed the crown should be covered up and allowed to slowly cool.

Finishing.

472. This step is so similar in all respects to the finishing of a porcelain-faced crown that we will not mention any of the details except to again emphasize the fact that the gold

should be finished *toward* the margin of the porcelain, never *from* it. Fine discs are used for making the surfaces of the crown smooth and uniform, so that no shoulder or irregular surfaces may be present.

Plain Logan Crowns.

473. In the preparation of roots for the reception of crowns of this class no enamel is removed and no peripheral trimming of root is necessary.

This crown depends for its retention upon the platinum post in the root, and for its protection from the lodgment of food and the products of decomposition on the closeness of the joint made while fitting, and on the quality of cement used in setting. It is, without doubt, a most excellent crown, as has been demonstrated by the thousands that have been giving service for years. This, however, is no argument against the use of banded crowns, and these are recommended because of the better protection afforded the root end.

Preparation of Root.

474. This is prepared usually with stones, as previously described. Since there is no band to be fitted in this case the end of the root is faced under the margin of the gum immediately. The lingual side may project slightly beyond the gum margin. The point where the joint between porcelain and root passes from under the gum margin to the outside should be as far to the lingual side as possible. In some cases the joint might be located entirely under the free margin, but as a rule more difficulty will be experienced in fitting the peripheral margin of porcelain to root, so that no shoulder may be present, when so fitted than when a portion of the joint is exposed. Face the end of the root flat, or with a slight labio- or bucco-lingual convexity. In addition to the stones the Ottolengui root facers are very convenient for reducing the end of the proper plane (see Fig. 173). These consists of steel discs, cut on their end with blades similar to the end of an inverted cone or fissure burr, but much larger. A central pin projects from the end which enters the canal when the instrument is in use, holding it in contact with the face and preventing injury to the gum margin.

Fitting the Crown to Root.

475. The canal, after being opened up with the small, round burr, is reamed out with fissure burs so as to neatly admit the pin, the crown pressed into place and the points of contact noted. These are then ground away and the porcelain thus brought into closer contact with root. Finally, a disc of articulating or ordinary transfer (carbon paper) paper is cut, passed over the pin, and the crown again carried to place.

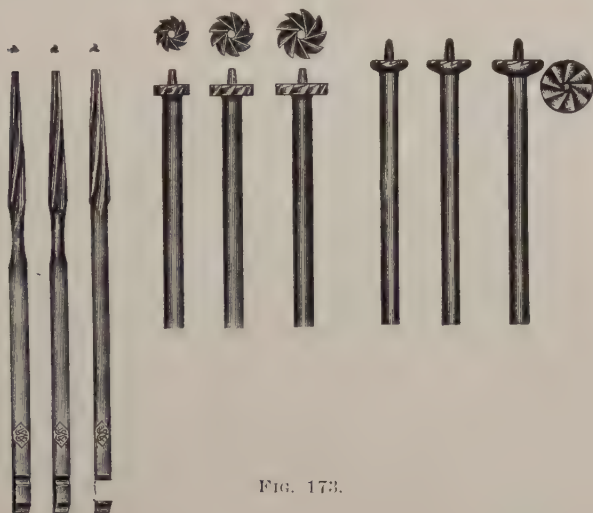


FIG. 173.

476. The points of contact are in this way plainly marked and the grinding continued until a perfect joint is obtained. In selecting this crown it should be as large at its cervical end as that of the root end. If larger it can easily be reduced. If smaller, a defect occurs which cannot be overcome, namely, a shoulder is formed by the projection of the root beyond the periphery of the porcelain, which will afford lodgment for food.

Setting the Crown.

477. The canal is dried out, the lips held away by placing pellets of cotton over the labial or buccal side of the root, the cement mixed and the canal filled to extreme end with it. A little is placed around the base of crown, which is then forced into position and held there until the cement has had ample time to set. Sometimes a disc of gutta-percha base-plate is

cut, perforated, and passed over the pin, the canal filled as described, the base-plate heated until quite soft and the crown forced in place. This fills the joint with a film of gutta-percha, a substance practically insoluble in this location, and affords a better protection to the root end than where cement alone is used.

478. When set, the surplus material is trimmed away, the gums kneaded with the fingers and given a treatment of hot water, and if tenderness of the tissues is apparent a treatment of saturated solution iodine in beechwood creosote, applied under the free margin of the gum, will usually relieve the trouble.

In most cases, gutta percha alone can be used with excellent results for setting crowns of this class.

CHAPTER XVIII.

Bridgework.

479. By bridgework is meant the replacement of some of the lost natural organs of mastication, with dummies of porcelain or metal, or a combination of both, which are attached to and held in position by crowns, set upon some of the remaining natural teeth or roots. In other words, bridgework may be said to be *continuous crownwork*.

480. A dummy is a modified crown, there being no occasion to construct a cap or set a pin in such a substitute. The expert crownworker, therefore, will meet with but little difficulty in constructing bridges.

481. It is interesting to note the gradual growth and evolution of modern bridgework since its inception some thirty years ago. It has only been by repeated and numerous failures that the dental profession has been brought to realize the limitations of this class of work. Its possibilities were realized long ago, and many became so enthusiastic as to believe that this was the only correct method of replacement of the lost natural teeth.

482. Their enthusiasm led them so far that bridges were constructed for almost every case of replacement which was presented. The numerous failures which followed as the result of this indiscriminate practice proved that the methods in vogue were inadequate in many cases. The experience of some having proven so unsatisfactory, the more thoughtful began to study closely the causes of the failures and how to overcome them.

483. It then became apparent that too little attention had been given to the amount of stress exerted by the muscles of mastication; to the strength of materials used in construction of the substitutes, to the amount of work the natural teeth or roots were capable of performing and to the means of preserving the teeth or roots, which were used as supports.

As a result, the study of these problems has given bridgework the place it justly deserves, and it is now one of the recognized and valuable methods of replacement of the lost natural teeth. With the experience of the past before him, and with a more accurate knowledge of methods and materials, the prosthetist, with discriminating care, is able to select only those cases where the conditions warrant its construction, and as a result of these methods of practice there are fewer failures to-day than ever before.

Conditions Favorable for Bridgework.

484. Since bridgework is not applicable to all cases where replacement of teeth is called for, a study of the favorable as well as the unfavorable conditions should be considered. The favorable conditions may be stated as follows:

First.—Mouths which receive care and attention are suitable for the introduction of bridges if other conditions are favorable.

Second.—Strong, healthy roots or teeth, to serve as abutments and piers to support the piece.

Third.—Proper position of these points of support.

Fourth.—Sufficient space to permit the use of ample material in the bridge to resist stress.

Unfavorable Conditions.

485. The unfavorable conditions are naturally the reverse of those just mentioned, namely, an uncleanly mouth, unhealthy condition of teeth or roots, insufficient number of supports and limited space. Very often a well-constructed plate would restore the functions of mastication and present a better appearance than would bridgework. This is especially true in those cases where a large amount of absorption of the alveolar border has occurred, and for æsthetic reasons it is necessary to restore the lost tissues. While bridges might be so constructed as to fulfill these requirements, yet, owing to the fact of their being more or less bulky, and that they are permanently fixed in the mouth, the tendency to collect and retain food at various points would preclude their use.

This objection is, of course, not applicable to dentures, nor to removable bridges, since these substitutes can readily be removed and cleansed. The success or failure of bridgework

depends upon the conditions as outlined, and to a study of these as well as any others which may be present, your attention should be especially directed.

Terms Used in Bridgework.

486. Dental prosthesis, especially in bridgework, has borrowed a number of terms from civil engineering and architecture. For instance, in civil engineering, the end supports of a bridge, those which abut the banks of the stream, are called the abutments, the central supports, or those between the abutments, are called piers, and the frames which carry the weight and support the roadbed are called the trusses.

In dental bridgework the teeth or roots which form the end supports of the piece are called the abutments, any intervening tooth or root to which the bridge is attached, and by which it is supported, is called a pier. In porcelain bridgework the platinum framework which crosses the span and supports the teeth and body of porcelain, and consequently carries the load, is called the truss.

Position of Abutments and Piers.

487. In order that the best results may be realized, a bridge should be supported by abutments at each end. If the space to be filled involves the replacement of three or more teeth there should be one or more intervening piers. Perhaps the ideal foundation for a bridge would be one root for every



FIG. 174.

tooth to be replaced. This would require each root to carry its own crown and the dummy crown of the missing tooth.

It must not be inferred from this that in case of the loss of one tooth it may be successfully replaced by crowning an adjoining tooth and attaching the dummy to it alone. While this plan is followed by some, and frequently with success, the principle is incorrect, and should not be carried out except under the most favorable circumstances. When there

is no occlusion, the opposite tooth or teeth being absent, or when the space to be filled mesio-distally is very narrow, and the root which is to carry the crown and dummy is long and firmly set in its socket, in such cases a bridge of this character might prove serviceable, but it is not recommended.

488. Frequently cases present themselves in which the central incisors are in position and the two laterals are to be replaced. In such instances the centrals are crowned and attached together and made to carry the laterals (Fig. 174).

489. Under proper conditions the two lateral roots may successfully carry two missing central incisors.



FIG. 175.

490. The two cuspid roots will often successfully carry the four incisors if the labial curvature is not too marked. When this is prominent, and the teeth must be set on a considerable curve, the leverage produced by this arrangement will, under the stress of mastication, have a tendency to push the roots of the teeth forward until they finally become permanently mal-posed (Fig. 175). Sometimes, by crowning the first bicuspid and attaching these crowns to the cuspids, this tendency to move forward is largely overcome (Fig. 177).

491. A bridge extending from the central incisor to second

bicuspid, or first molar, without an intervening point of support, would most certainly prove a failure if subjected to use, for the reasons already given, namely, the curvature. The idea is this, that in arranging the dummies in work of this class they should be set in as nearly a straight line as occlusal conditions will permit, or as the æsthetic appearance of the case will warrant, in order to avoid the tendency to displacement under stress. If the force exerted by the muscles



FIG. 176.

of mastication is considerable, and the occlusal or æsthetic conditions demand the arrangement of the dummies on a marked curve, and there are no intervening piers, a bridge would certainly be contraindicated, regardless of how favorable all the other conditions might be.

Fig. 176 represents two cuspid and the two second bicuspid roots serving as abutments and piers. This, under ordinary conditions, would be a favorable case for bridgework.



FIG. 177.

492. A long, firmly set cuspid root, in good condition, and a second or third molar will often successfully carry dummies which fill the intervening space without an intervening pier, although the latter would certainly add to the stability of the substitute.

493. The crowns on two proximating teeth or roots may be united to increase the stability of the anchorage in some cases, but when so attached they should be constructed so

as to leave ample space for the gum tissues in the embrasures and interproximate space (Fig. 177).

If closely united to the extreme cervical margins of the bands the soft tissues are compressed in setting the piece, and more or less permanent injury results.



FIG. 178.

Fig. 178 A represents a full denture bridge carried by two abutments and two piers. Such a bridge is seldom ever advisable when supported by so few roots. Accidents are almost certain to occur in construction or when set in the mouth so that under only the most favorable circumstances should such extensive substitutes be constructed.

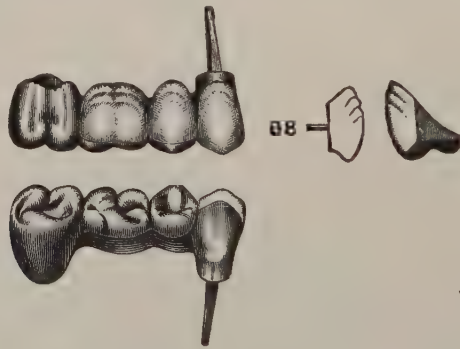


FIG. B.

B represents a condition frequently met, in which both bicuspsids have been lost and the cuspid and first molar are used as abutments to carry the dummies. This is usually one of the most satisfactory locations in which to introduce a bridge.

494. The teeth or roots, which serve as abutments and piers, should be parallel with each other, or be made so in their preparation, or more or less difficulty will occur in placing the bridge in position. Very slight variation from parallelism is of no consequence in some cases where the peridental membrane is thick, and the roots of the teeth can be moved sideways in their sockets, to a certain extent, in starting the bridge in position, while setting, but as a general rule parallelism of abutments and piers should be secured.

Construction of Bridge.

495. In the construction of bridges it is necessary to first *complete the crowns* which rest upon the abutments and piers, to which the dummies are to be attached. This is advisable because there will be less danger of the relation of the various parts becoming distorted in the final assembling and soldering of the bridge. The instructions given in regard to root preparation for crowns apply in all respects to the class of work under consideration.

496. The crowns, having been completed and placed upon their respective roots, a bite in beeswax is first taken. This is removed and, with the crowns still in place upon the roots, an impression in plaster is secured and removed. If the crowns do not come away with the impression they should be removed and placed in it, in exact position, and a model secured.

The bite, having been taken while the crowns were in place, will readily go to position on the model. The case is now mounted on the occluding frame, and dummies, of proper form and width to fill the intervening spaces, constructed. These are made in various ways, according to the class of work being constructed, and the teeth to be replaced.

Porcelain-faced Dummies for the Anterior Teeth.

497. The construction of dummies of this class is usually quite simple. The facings at their cervical ends are ground to fit the border and beveled at their incisal ends to permit the tipping of the porcelain with gold.

The backing, of 29 or 30 g. 22-k. gold, is cut, punched, annealed and adapted to the lingual surface, as described in crown construction.

It should extend from the angle formed by the junction of the ridge lap with the lingual surface of facing (Fig. 179a) over this surface, and a trifle beyond the incisal margin of the labial face *b*. The pins are then shaved and the spurs bent over to hold the backing in place. The sides of the backing should be trimmed even with the porcelain.

498. When two, three or more dummies are to be placed side by side better results can be attained by flowing solder of high grade over the backing of each tooth before the various parts are assembled, or, in other words, constructing each dummy complete by itself.

When only one or two dummies are to be placed together this step is unnecessary, as the solder which connects the various pieces can also be flowed over the dummies to give the proper lingual contour to the piece.

499. The object in completing each dummy by itself, where several are lined up side by side, is to prevent the tendency



FIG. 179.

to warp, which often occurs in the final connecting together of the various parts of the bridge. This tendency to become distorted is more marked in bridges of considerable curvature and length than in short ones, or those arranged in a comparatively straight line.

500. The backings of contiguous crowns and dummies should be in absolute contact on mesial and distal surfaces, and if, in trimming away the surplus backing material and arranging the parts, a space exists, it should be filled in with a wedge-shaped piece of plate of the same grade as the backing. By having absolute contact of the metal parts the tendency of the porcelain to check, during the contraction of the solder in cooling, is obviated. If possible arrange the facings so as to leave a space the thickness of a piece of tissue paper, between them. This is imperceptible to the eye, and should contraction occur there will be practically no danger of breakage.

Construction of Porcelain-faced Bicuspids and Molar Dummies.

501. Facings for dummies of this class are ground, fitted and backed as just described, the lingual sides of the buccal cusps being beveled the same as in the anterior facings, at an angle of 45 degrees to the lingual plane.

The facings are now lined up on the model and held in position by a little wax melted between their ridge lap and the model.

Plaster is built up against the lingual surfaces and over



FIG. 180.

the buccal tips, and while soft the plaster teeth on the opposite side of the occluding frame are pressed into it. When set, the cusps are carved, as described in crown construction, the dummies separated, counter-dies are secured and the cusps swaged. The plaster cusps are then broken away from the facings and the buccal margins of the cusps cut away so as to accurately fit the surfaces of backings (Fig. 180a), which extend over the buccal tips of the porcelain.

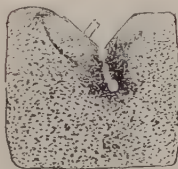


FIG. 181.

The cusps are then waxed in position and the dummies, thus assembled, are tested as to their correctness in full and partial occlusion. If found correct they are ready for investment, and if incorrect the defects should be remedied at this time.

Investment.

502. The dummy should be so invested that the lingual margin of the cusp (Fig. 181) and the cervical termination of the backing should be on a horizontal plane. The solder,

when fused, will then seek its own level and give the proper lingual contour to the piece.

The entire joint between the backing and cusp should be exposed just as described in the investment of an ordinary porcelain-faced crown, in order to insure the perfect union of these parts.

The wax is then removed, borax and solder applied and case soldered. When cold the piece is finished up with files and stones, but is not polished at this time.

Use of Metal Dummies.

503. Porcelain-faced dummies should be used as far back as the first molars, when the case will permit, but frequently, where the space is limited, it is not advisable to use them. In such cases dummies constructed wholly of metal are used.

Metal dummies are less liable to injury, under stress of mastication, than are those constructed with porcelain faces, and as a consequence, substitutes of this class are often used to replace the bicuspid in mouths where these teeth are not visible in speaking and laughing. They are constructed in various ways, one or two of the simpler methods of which will be given.

Construction of Metal Dummies.

504. Construct a band of gold, which, when contoured, will be of correct outline of tooth to be replaced. Set it in position on model and fill with plaster and close the occluding frame. Carve the cusp, construct counter-die, swage, fit and solder gold cusp as for an ordinary crown. Cut out the



FIG. 182.

lingual surface of band, as indicated in Fig. 182, to give proper lingual contour to the substitute. In soldering the cusp in place it should also be thickened, as in crown work.

To the beveled lingual surface a piece of plate is now burnished. Borax is placed around the joints, solder placed in position and the plate held by one corner with a pair of

pliers, as shown in Fig. 183. It is then passed into the flame and soldered. The surplus is cut away with shears, files and stones, and it is ready for assembling.



FIG. 183.

505. Sometimes these metal dummies consist merely of cusps, no attempt being made to restore buccal or lingual surfaces to any extent. (Fig. 184a). The space between the

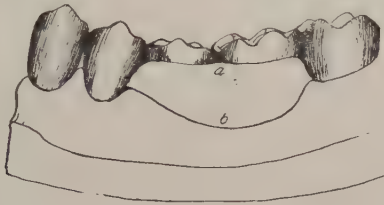


FIG. 184.

cervical end of cusp and border (*b*) being thus quite open, the food can readily be dislodged with the tongue. When constructed in this manner a cusp of proper form is carved, a counter-die secured, the cusp swaged and filled solidly with solder.

Assembling the Abutments, Piers and Dummies.

506. The crowns should be removed from the model, being careful to mutilate the plaster matrix in which they set as little as possible. The plaster in the bands is cut out and the crowns returned to position on the model. The dummies are then set in position and waxed to crowns, and to each other, but not to the model. The assembled bridge should now be finally tested in full, as well as partial, occlusion, and any adjustment that is necessary made at this time. The crowns, having previously been removed, will now come away readily with the entire bridge.

Investment.

507. The investing material is next mixed and the bands perfectly filled with it, after which the investment proper is

built up on a glass slab to proper depth and size and the bridge evenly pressed down into it, to correct position. The investment for bridges of ordinary size should be about 10 mm. deep between the porcelain and base. When set the investment is trimmed to proper form, cutting away the surplus material at all points where the free passage of the blowpipe flame would be interfered with. The wax is removed by warming and the use of instruments, and afterward with hot water.

Borax paste is distributed in a thin, even layer all over the metal parts where it is expected that the solder will flow. If it is necessary to introduce any wedges of plate between the backings, as previously mentioned, it is done at this time. The solder should be cut in rather large pieces, entirely covered with borax, and placed between the dummies and crowns in sufficient quantity to furnish the proper lingual contour to the piece. This having been accomplished, the case is ready for soldering.

Soldering the Bridge.

508. The investment containing the bridge is set on a piece of thin metal or wire gauze and placed over the flame to dry out and become heated. When the moisture is all driven off, the blowpipe flame is directed around the base of the investment, so that the porcelain may become thoroughly heated up and expanded before the flame is directed against the metal pins. The sides of the investment should show a bright red heat before any attempt is made to flow the solder. When brought to this condition the large, soft flame of the blowpipe is directed evenly over the entire exposed metal parts until the solder begins to fuse. Care should be taken not to heat one part more than another or to *overheat* any portion, as there is always a tendency for the gold plate itself, in the presence of the solder, to fuse. When this does occur it frequently becomes necessary to reconstruct the whole bridge. The proper amount of care bestowed at this time will avert this difficulty.

The soldering can usually be readily accomplished with a blow pipe of the type represented in Fig. 185, or with the gasoline or alcohol blow pipes illustrated elsewhere.

509. After the solder has fused the flame should be continued on its surface for a short time so as to maintain it in a fluid

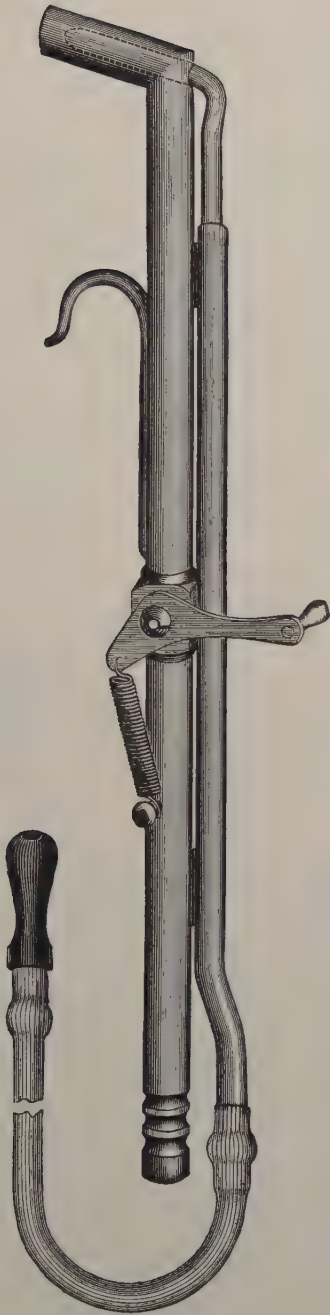


FIG. 185.

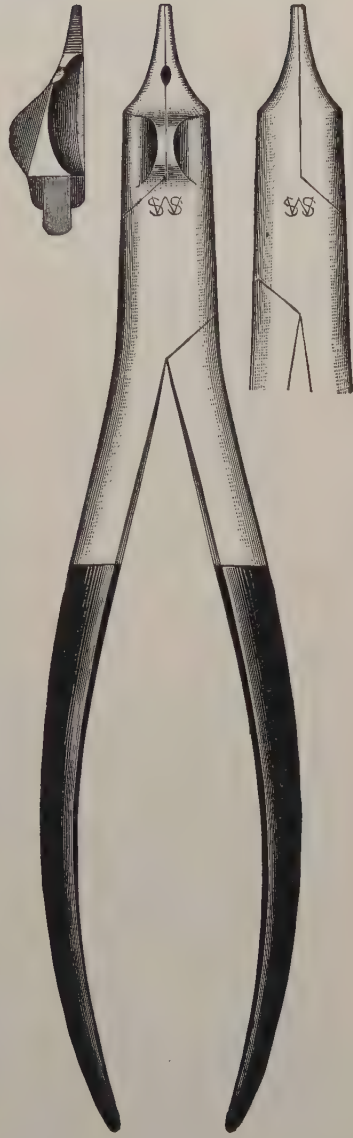


FIG. 186.

condition, without increasing the temperature, in order to expel the borax that may be in the deeper parts. This point has been mentioned before as the cause of pitting, and it is well to bear it in mind. Should the solder first placed not give sufficient lingual contour more should be added as quickly as possible so as to maintain the work at as uniform temperature as possible. Heating and cooling the case a number of times is almost certain to check the porcelain. Right here it might be stated that there are three principal causes of porcelain facings checking—first, and most common, contact of borax with the porcelain; second, expansion of the metal pins before the porcelain has had time to expand, and third, sudden heating and cooling of the piece, which, of course, produces sudden and unequal expansion and contraction of all metal parts as well as the porcelain.

Finishing.

510. When soldered, the case should be covered with something to exclude the drafts and allowed to cool down slowly. It is then removed from the investment and pickled, the surplus metal parts cut away with stones and files, and it is ready for the final finish. Sandpaper discs, in the engine mandrel, can be used to good advantage in smoothing up the various irregular surfaces, and when the scratches are all removed in this manner the felt wheel on the lathe, carrying pumice stone first and afterwards whiting and water, is used to give the final finish.

Setting the Bridge.

511. When finished the bridge should be first tried on the roots in the mouth to see that everything is all right. If found correct the piece is dried, the root canals and face ends of the roots are wiped with cotton and afterward rendered free from moisture with blasts of warm air. If the piers and abutments consist altogether of post and cap crowns then the directions in regard to setting these crowns apply here. If one or more are shell crowns then the interior should be filled, to a greater or less extent, with cement, according to the amount of bulk in the tooth or root over which it is to be placed. The bridge is then carried into position and pressed to place.

The patient can often materially assist the operator by biting on a square piece of pine stick placed between the crowns and piers alternately and the opposite teeth. The parts should be guarded as far as possible from the encroachment of saliva and mucus until the piece is set. The patient should be instructed to close the teeth so as to test the piece, in full and partial occlusion, before the cement has had time to set, so that, should anything be radically wrong, the bridge may be removed without difficulty.

512. Gutta-percha is also used for setting bridges and crowns as well. Substitutes, when set with this material, can be readily removed without mutilation, by heating with blasts of hot air directed upon the metal parts of the crown. A little device very convenient for this work is to remove the bulb of a chip blower and attach to the nozzle a piece of rubber

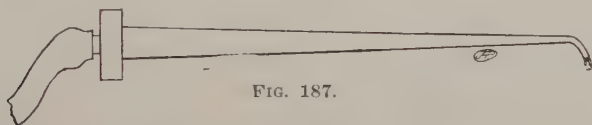


FIG. 187.

tubing connected with the gas supply. The gas is turned on and lit and the valve turned so as to admit just enough to produce a Bunsen flame (Fig. 187) one or two mm. long. This, being so small, is easily controlled, and the heat can be applied wherever needed. Care should be taken not to heat the piece so hot as to burn the tissues.

513. A piece of gutta-percha base-plate is cut and shaped in the form of a cylinder and passed into the canal and heated, or it may be heated before being introduced, the crown is heated somewhat and pressed up into place as far as possible, and then removed; the surplus gutta-percha cut away, that in the canal again heated and the crown returned to place and pressure again made upon it until it takes its proper position.

514. Previous to introducing the gutta-percha the canal should be moistened with oil of cajuput or eucalyptus, either of which is, to a certain extent, a solvent of this material. The oil insures a closer adhesion of gutta-percha to canal.

This method of attaching crowns and bridges is recommended by many for the reasons already given, and especially is its use advocated when large porcelain bridges are to be set.

CHAPTER XIX.

Removable Bridges.

515. The appliance known as a bridge is one which, in appearance and use, is intended to replace some of the lost natural organs of mastication, and which is attached to and retained in position by some of the remaining natural teeth or roots. The definition just given applies equally well to a removable bridge, with this exception, that the latter is so constructed that it can be attached to or detached from its abutments and piers by either patient or operator without injuring or mutilating the bridge or its attachments.

516. Removable bridges are recommended, in favorable cases, first, for hygienic reasons, as they can readily be kept clean; second, by their use lost tissue can be more perfectly restored, a condition not possible to the same extent in many cases, in ordinary bridgework, since fixed appliances in which much restoration is attempted, invite the lodgment of food; third, they are less cumbersome and more comfortable than plate dentures.

517. In all cases where bridges of this class are constructed the preservation of the abutments and piers is one of the first considerations. These must be protected in such manner as to prevent their dissolution by caries, for, regardless of how well the appliance may be made, if the foundations give way, failure will result. The roots or teeth which support the piece are usually protected by caps which extend far enough under the free margin of the gum to afford ample protection from the products of fermentation. To these crowns or caps are attached various devices for holding the bridge in position. They range from simple to quite complicated forms, the simpler ones of which will be here explained.

518. First: The telescoping crown method.

Second: The tube and split post method.

Third: The Parr System.

- Fourth: The Curtis System.
Fifth: The Condit System.
Sixth: The Griswold System.

The Telescoping Crown Method.

519. This system consists of a bridge to which are attached shell crowns, which telescope over protecting caps on the abutments and piers (see Fig. 188). These protecting caps, *a b*, which constitute the foundation on which the bridge rests, must be formed with parallel sides, and so set upon the roots as to be parallel with each other, and therefore parallel with the direction in which the appliance is placed in and removed from its position.

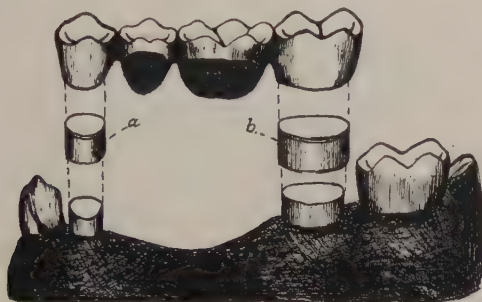


FIG. 188.

520. The crown bands, having been fitted to the caps, are placed in position, and a bite and impression taken, the case mounted on an occluding frame and the crown completed in the ordinary manner. They are now returned to the mouth for a final bite and impression, again mounted on the frame, the dummies constructed, the several parts assembled and the bridge completed. In this class of bridge, as well as in most of those of the removable type, a saddle is permissible and often advantageous.

The Tube and Split Post Attachment.

521. This method is frequently used in single root teeth, and under proper conditions is quite serviceable. It obviates the display of gold such as occurs in the one just described, since the attachment itself may be covered by a porcelain crown

or facing. The root canals of the abutments must be parallel or rendered so in reaming out or this method is not applicable.

522. The construction of a bridge of this form, briefly described, is as follows: The abutment roots are prepared in the usual manner, cutting the labial portion slightly under the free margin of the gum. Bands are fitted, caps constructed and the canals properly reamed out. To the canals are fitted tubes, the inner diameter of which is large enough to receive the 16 g. iridio-platinum wire, constituting the post and support of the removable portion. The tubes are fitted to the caps so as to

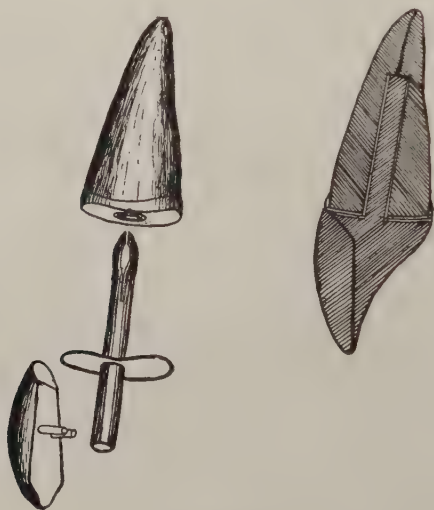


FIG. 189.

coincide with the reamed-out canal. They should extend as far into the canal as possible, to afford a firm foundation for the bridge.

523. An impression with caps and tubes in position is now taken, the case poured and these parts soldered together. This step is precisely the same as securing the relation between pin and cap in ordinary crownwork. They are then returned to their proper places and cemented in position. The posts are then fitted to the tubes, passing them in full length and allowing them to project two or three mm. beyond the caps for attachment purposes. A disc of metal, a little larger than each cap, is cut and a hole punched for the pin. The two are soldered

together and placed in position on the cap for final adjustment. Fig. 189 indicates the various parts of this crown.

The disc should be conformed accurately to the end of the cap with burnishers.

The end of the pin, passing into the tube in the root canal, can be split with a thin-blade saw for perhaps one-third its length and the divided portion spread slightly, so as to act as a spring, to hold the substitute firmly in position. When properly adjusted a bite and an impression is taken and the case mounted on the occluding frame. The case is now constructed as an ordinary bridge would be, except that the crowns forming the abutments are without bands, these being unnecessary, since the caps carrying the tubes afford ample protection to the root.

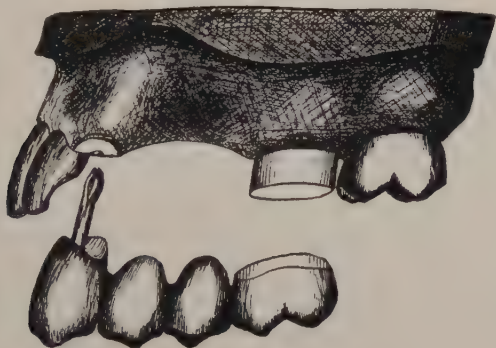


FIG. 190.

524. The most favorable position for this class of bridge is in the anterior part of the mouth, where the cuspids or central incisors are used for abutments. Sometimes when the bicuspid is to be replaced an attachment of this form is used on the cuspid, and the telescoping crown method before described used on the molar. (See Fig. 190.) Different methods of attachment may at times be combined in the same bridge to good advantage, according to the conditions of the case.

The Parr System.

525. This method consists in first crowning the abutments with suitably shaped crowns, constructed in the ordinary manner. To these crowns are attached projecting dovetailed pieces placed parallel with the long axes of the teeth, and as in the

method just described, they must be parallel with each other, and consequently with the direction in which the bridge is placed in and removed from its position (Fig. 191). Shell sockets are conformed to the dovetailed projections, and in the subsequent steps of assembling the dummies these sockets are placed in their proper relation and solder flowed around them, thus affording a rigid support for the piece *a*. The details of construction are so similar in this class of work to that already



FIG. 191.

described that the manner of making the projection and socket only will be given.

526. The dovetailed piece can be made of varying width, depending on the occluso-gingival length of crown to which it is to be attached. It should not be narrower bucco-lingually than two mm., at the point of its attachment to crown, for if less than that, its bearing on the crown wall might be insufficient to withstand the stress and give way under it. The

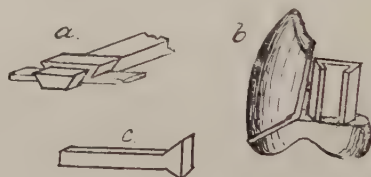


FIG. 192.

length, as before stated, varies according to length of crown. It might be stated that the projection should be as large as possible, without its encroaching unnecessarily on the space the dummies should occupy. The projection is made, first, by taking a strip of thin platinum plate and bending it into the desired dovetailed shape over a mandrel (*a*), filling the inner portion with wax, investing, washing out the wax and flowing gold plate into the matrix thus formed. The projecting ends

are then trimmed away, the piece fitted against the crown in proper position, an investment made and the two soldered together.

527. The socket is formed by adapting another piece of platinum plate to the dovetailed portion already constructed, investing and flowing solder outside in order to stiffen it. Frequently the two strips of metal, the one for the projection and the other for socket, are bent into dovetailed form together, then separated and completed in the manner just described.

528. To secure the relation between the socket, the dummies and the projection which is now attached to the crown, is a step requiring care. The crowns are placed in position on the abutments, the sockets adjusted in place on the projections and the dummy piece (*b*), constructed in skeleton form only, is carried to and held in position between the abutment crowns, while adhesive wax is melted around the socket and against the lingual sides of the dummies.

529. The piece is then removed and invested in such manner as to hold the sockets in proper position while being soldered. A piece of plate (*c*) can be bent or shaped so as to fit the interior of the socket and project out into the investment, thereby affording support to the socket during the soldering. The socket or that portion not occupied by the stay should be perfectly filled with investing material to prevent the solder from flowing in and filling it up, for if this should occur the fit of the piece will be impaired. This method has been used in many cases successfully.

The Curtis Method.

530. This method is one that is recommended very highly by Dr. Curtis and in a general way is similar to the Parr System. The dovetailed part of this attachment is projected on the end of a bar of metal of varying length and width. (See Fig. 193.) the head or dovetailed portion is formed in a steel matrix, while the socket is made by conforming a piece of plate around this and stiffening it so that it will retain its shape until permanently soldered to the dummy, which in this system is accomplished before the bars carrying the dovetailed ends are attached to the crowns. The sockets, having been properly set, are soldered to the dummies, the lingual surface being filled in completely (*b*).

531. The arms are now placed in the sockets in the dummy and the piece fitted into position between the two abutment crowns, care being taken to make the adjustment of arms to crowns accurate. The arms should be somewhat wider than the sockets, so as to project a little beyond the lingual contour of the dummy (Fig. 194). When the fitting is completed the model is varnished and sticky wax is flowed against the pro-

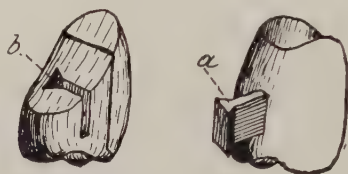


FIG. 193.

jecting portions of the bars, the dummy removed, and the case invested so that the bars may be held in the proper relation to crowns while soldering.

532. In setting the piece, the bars, which are now attached to the crowns, are placed in their respective sockets, the crowns partially filled with cement and the entire piece forced into position at the same time. Care must be taken when waxing the sockets in position on the dummy to so place them that their



FIG. 194.

sides will be parallel with the direction in which the piece is adjusted in and taken out of position, since if not so placed it will be impossible to remove it, and the object for which it was so constructed will be defeated. There are various other forms of attachments, but the ones described are perhaps the most practical. Two more, however, will now be described, as in many cases they are of more practical application than any of the others mentioned.

The Condit System of Attachments.

533. This system consists, essentially, of two telescoping tubes which fit each other accurately and of a wire or central post which also fits the inner tube closely, and which is attached to the outer tube by means of a disc in such manner as to place it parallel with and in the center of the larger or outer



FIG. 195.

tube. Both tubes are open on the sides, the inner one for the reason that its ends may be bent to more firmly grasp the central post, and the outer one to permit of its passing to position over the inner tube when that piece is attached to the crown. The ends of this tube may also be bent so as to more closely grasp the inner tube, thereby insuring greater steadiness in the piece when subjected to stress (see Fig. 195).

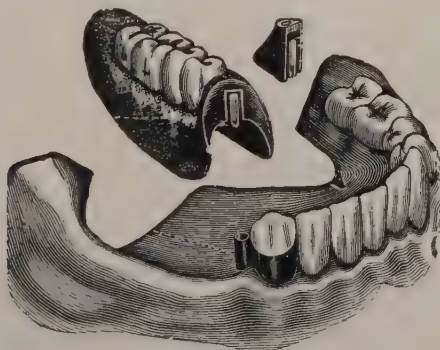


FIG. 196.

534. These appliances may be procured at the supply houses and are more generally applicable to the construction of partial dentures of vulcanite rather than combining them with gold crown and bridge work. In well-selected cases dentures carrying such attachments give most excellent results.

535. If the case is one requiring two attachments, as in Fig., 197, the anchoring tubes attached to the crowns must be sol-

dered so as to be parallel with each other, although the abutment crowns need not necessarily bear that relation to each other. Securing the relation between the crowns bearing the inner tube attachments, and the outer tubes which carry the removable piece, is a step requiring care and precision. The crowns, having had the tubes soldered to them, are placed in position on the abutment teeth; the outer tubes are now fitted to place and an impression and bite taken.

536. Should the crowns come away with the impression they should be removed and pieces of German silver tubing, corresponding in size with the smaller tubes, and about one-half

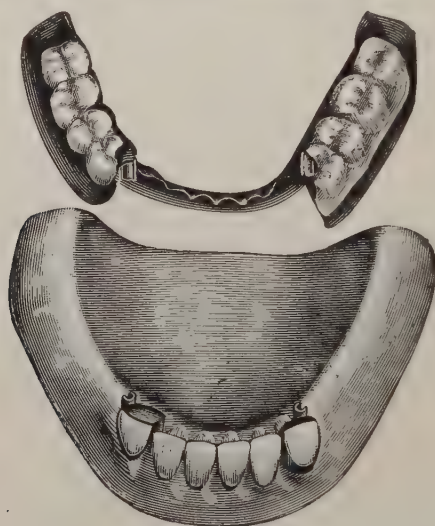


FIG. 197.

inch in length, be placed into the larger tubes which are to carry the removable piece, and the impression poured. These tubes will prevent the displacement of the attachments during the waxing, packing, flasking and vulcanization of the piece. The crowns, if left in the impression and the case poured, would afford support to the attachments, but the rubber, during the closing of the flask, would be forced between the two tubes and it would be difficult to separate the crowns from the removable piece after vulcanization.

Fig. 196 shows a frequently occurring condition in which this appliance can be used to advantage without the necessity

of extending a band of metal or vulcanite across the lingual surfaces of the anterior teeth.

Fig. 197 is a case where the bicuspsids and molars are to be replaced. Crowns on the cuspids carry the anchoring attachments.

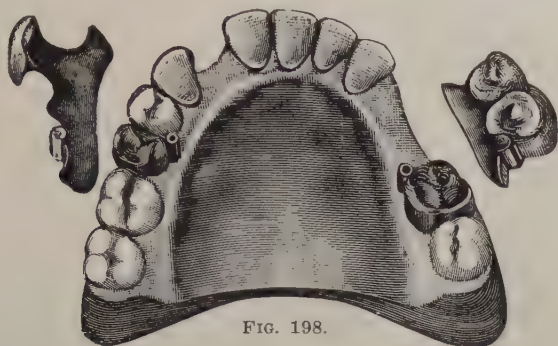


FIG. 198.

Fig. 198 shows methods of replacing one or two teeth by means of a single attachment and a very small base-plate.

537. This method of attaching partial dentures to some of the remaining natural teeth is very convenient, and often enables the prosthetist to make a replacement that by other methods might prove more or less unsatisfactory. Fig. 196 shows the application of this system to cases in which only one attachment can be used. In such cases the ridge must necessarily be prominent to prevent displacement of the denture in the mastication of food.

The Griswold System.

538. This system consists of two box-like attachments, one telescoping into the other, made of spring metal, the inner one being attached to an artificial crown and the outer one imbedded in or attached to the substitute. The system is applicable to cases in which the substitutes are constructed of metal or it

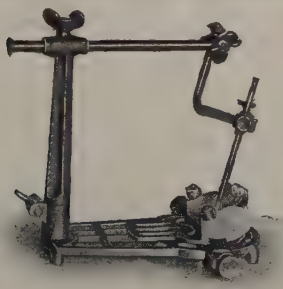


FIG. 199.



FIG. 200.

can be applied to the construction of rim vulcanite dentures. In this system as in all of the other methods given it is absolutely necessary that the attachments be placed parallel with each other and parallel with the direction in which the piece is introduced into and removed from position in the mouth.



FIG. 201.

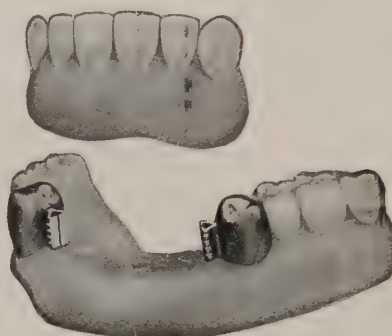


FIG. 202.

539. The soldering of the several attachments is accomplished by constructing a model of investment material carrying the crowns to which the appliances are to be attached. This model is placed on an appliance called a soldering jig (see Fig.



FIG. 203.

199), which holds the attachments parallel to each other while being soldered. The method outlined in describing the Condit attachments of securing or holding the attachments in position during the packing and vulcanizing of the case is applicable also to this system. Figs. 200, 201, 202 and 203 show the application of this principle to several cases of partial dentures.

CHAPTER XX.

Detachable Facings.

540. Very often, after assembling the various parts of a crown or bridge and subjecting them to the blowpipe flame, the porcelain will be found to have changed color or to have cracked during the soldering process. Any means taken to correct either of these accidents when they occur is more or less unsatisfactory, because the piece becomes, to all practical purposes, a makeover or repair. It has been the dream of some prosthetists for a long time to devise a facing or crown that, when adjusted to place, could be removed from its position on the metal framework during the soldering process, and again replaced after this had been accomplished. Or in case a facing on a crown or bridge should be fractured, while in use in the mouth, another one of the same form could be selected and fitted without removal from the abutments or piers, thereby avoiding the mutilation to the metal parts which removal so frequently entails.

A number of these detachable crowns and facings have been invented and placed on the market, a few of the most important ones of which will now be described.

The Mason Detachable Facings.

541. This system is one in which the attachment of facing to backing is obtained by means of a triangular bar of platinum attached to, and running parallel with, the long axis of the tooth, and which fits into a corresponding dovetailed slot in the backing that accompanies each facing (see Fig. 204a). In constructing a crown where these facings are used the method is as follows:

The root is prepared in the usual manner, the band and cap constructed and the pin attached thereto, setting it well to the lingual side of cap, so that the projecting portion of the pin will not interfere with placing the facing in any position desired.

The cap is set in correct position on the root, an impression taken, models constructed and case mounted on lateral motion occluding frame. The facing is then ground to position against the cap, being careful to secure as perfect contact of porcelain with metal as possible. When this has been properly accomplished the backing is slipped in position on facing and scribed to the cap. It is then removed and sawed to the line thus marked, placed in position on facing and then waxed in correct relation to the cap. The parts thus assembled and held together by the wax are removed from the model, and the facing slipped out of its position *b*. The cap and backing, still held together by the wax, are invested in the usual manner.

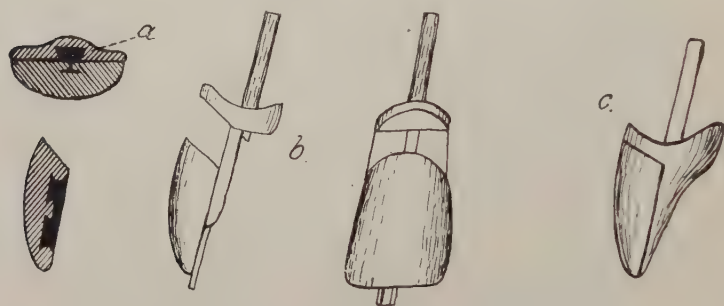


FIG. 204.

542. The slot in the backing which receives the triangular bar of the facing should be perfectly filled with investing material, otherwise it might become filled with the solder, while attaching the cap and backing together. Proper lingual contour should be given to the crown, as in the case of any porcelain-faced crown. When the soldering is accomplished the piece is removed from the investment and thoroughly cleaned and pickled. The facing is again slipped into place and any projecting portions of backing trimmed even with margins of facing. The polishing is accomplished in the usual manner on the lathe, while the porcelain is in position. The facing should then be removed, the metal parts cleaned from all debris, thoroughly dried and the facing cemented in place, allowing the cement to cover the ridge lap as well as the space between backing and porcelain. When the

cement has set the surplus should be removed and the crown set in the usual manner.

543. In constructing a bicuspid crown with full occlusal surface the cusp is cut away on the buccal marginal ridge, and this cut surface set over or fitted against the backing. If set over the end of the backing, a slot corresponding to the dovetailed groove in the backing should be cut in it to permit the facing being passed into and removed from position. The remainder of the steps, being so similar to those already described, will not be mentioned. When dummies for bridges are to be constructed, the cervical end of the slot in backing should have a small piece of plate fitted and soldered into it to act as a stop to the facing, otherwise, there being nothing to support the porcelain but the adhesion of the cement, it would be forced upward (Fig. 205*d*) against the border when subjected to stress. The cervical end of the

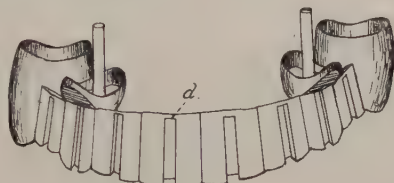


FIG. 205.

dovetailed bar should be cut off at such point that it will rest firmly against the stop, when the facing is set in proper position.

544. These facings will stand a reasonable amount of stress only and should not be set so as to take the full force of stress exerted by the muscles in mastication. Should they break, however, it is only necessary to remove the bar in the slot and replace with another facing of correct form and color. It is a good idea to make a record of the shade and number of facing used in each case, so that in case of accident it is a comparatively easy matter to find one to replace it.

545. In constructing a bridge by this method the facings are selected of proper width to fill the space and ground to position, the backings are then placed on the facings and trimmed on their mesial and distal margins until they neatly touch each other, when the facings are in contact and in

position. Hard or sticky wax is then flowed over the backings, and when quite cold, the facings are slipped out of place, the waxed backings removed from model and invested. Care should also be taken in such cases to fill the slotted groove in backings for reasons previously mentioned.

The Wedgelock Facing.

546. This facing was invented by Dr. F. N. Roach, and has some points of merit not possessed by other forms of removable facings. As the variety of shades and shapes are somewhat limited, its universal application is restricted.

The tooth as now constructed is a flat back facing with a single heavy pin of iridio-platinum. This pin has a strong, heavy head, so formed as to present a wedge-like inclination to the lingual surface of the backing.

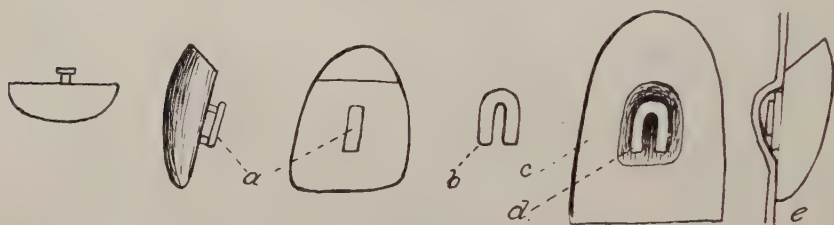


FIG. 206.

547. The backing which accompanies each facing is of pure gold 34 g., depressed in the central portion. In this depressed area is fitted and soldered a slotted diaphragm which receives the pin on the facing. As the pin enters the slot and is forced toward the closed end of the diaphragm, the tooth is drawn into close contact with the backing. The backing is adapted to the facing around the peripheral portions by burnishing.

548. One advantage of this system is that the incisal or occlusal edge of the facing may be beveled and covered with metal to protect it from stress and yet be passed into and removed readily from position.

549. The method of crown construction is simple. A tooth of proper color and form is selected to meet the required conditions and ground to fit. The backing is slipped over the pin, the sides burnished to conform accurately to

the porcelain (*f*, Fig. 207), and the surplus margins trimmed away. The porcelain with backing attached is set in position on the cap *g* and waxed as in ordinary cases. The facing is now removed from position and the small depression and slot which receives the head of the pin is filled with investing material *h* and the case invested and soldered in the ordinary manner. When this step is completed it should be pickled and perfectly cleaned, the facing replaced and the surplus

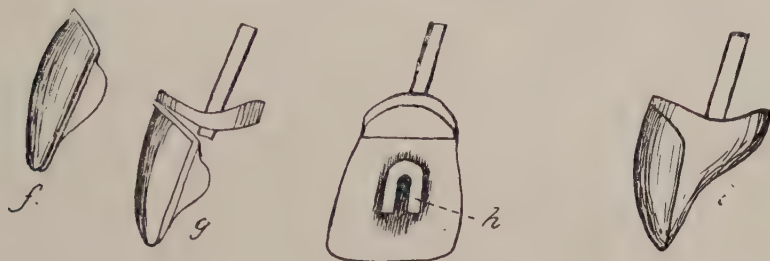


FIG. 207.

metal cut away with files and stones and polished. The facing can now be removed and all parts cleaned from the polishing material and debris, and the facing set in place with cement or gutta-percha, as indicated at *i*.

Fig. 206 shows the several parts of this set, *a* the lingual and side view of the facing, *b* the slotted diaphragm, *c* the backing, *d* the diaphragm attached to the backing, *e* the facing and backing in contact.

The Dwight Facing.

550. This system depends upon the retention of the porcelain to its backing by means of a square socket or box of platinum (*a*, Fig. 208), which is baked in the lingual side of facing, which receives a projection from the backing. Accompanying the facing is a square post of approximately same size as box, turned and threaded on one end, and the other cut out in the center so as to leave two flanges or thin wings of metal, which can be spread so as to act as springs, and press upon the sides of the platinum box in the tooth *b*. The square portion of the pin is no longer than the depth of the box. This brings the shoulder of the threaded portion down on a plane with the lingual surface of the facing.

551. The method of using the facing is simple. Place the facing, flat side down, on the piece of gold that is to be used for the backing and locate point to punch hole for threaded end of post. This is then reamed out and threaded to receive the threaded end of post *c*. The latter is now screwed tightly into position on the backing, the facing adjusted and the backing burnished closely to it (*d*, Fig. 209). The two, while still sustaining this relation to each other, are now placed and waxed

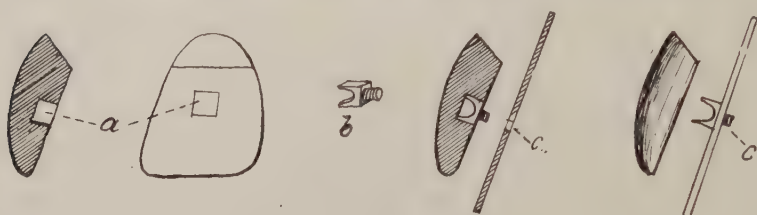


FIG. 208.

in position on the cap, which is constructed in the usual way, the facing is then removed, *f*, and the investment of the parts in proper relation to each other is made. The backing and cap are connected with solder and the lingual contouring of the tooth accomplished, *g*.



FIG. 209.

552. The inventor claims for this system that in addition to its use as a removable facing, with it repairs in ordinary bridgework can be much more easily accomplished than by any other system. The method of repairing is carried out as follows: When a porcelain facing is to be replaced the broken fragments of the old facing are removed, the pins cut off even with the backing and a tooth to suit the conditions as to shade, shape and color selected. With a pair of

stiff spring dividers measure the distance from the cervical end of the tooth to that margin of the box matrix and transfer it to the old backing, making the measurement from the point where the ridge lap touches the border downward. This marks the line on which the cervical margin of the post will rest. One-half the width of the post, in addition to this, will give the exact center for drilling the hole in backing. When this point has been found and drilled it is then threaded and the post screwed into place. In case the sides of the post set diagonally or at any angle other than parallel with the long axis of the facing to be attached, it should be removed and a shaving of gold from the backing cut away to allow of its being turned to correct position. It is then replaced, the facing set on it and adjusted correctly in place.

553. When the fitting has been accomplished the box is filled with cement, the lingual surface covered with a thin layer and the facing replaced and pressed into place, using force enough to bring the porcelain in direct contact with the backing, and expel all surplus cement. The cement in the socket surrounds the square end of the post and the attachment of porcelain to post is obtained in this manner, while the post itself is screwed tightly into the backing, thus anchoring the facing firmly in position.

At the present time great interest is being manifested in the production of porcelain tooth bodies which will have more inherent strength after baking, and be more resistant to stress than any which are now produced, and it is only a question of time until some system of removable facings will be found that will supersede the old or present method of subjecting the porcelain to heat.

The principal difficulty met with in the use of the forms of facings already described is on account of the limited varieties of shades and forms of the facings, while some of the systems are not even yet procurable. Efforts are, however, being made to produce and place them on the market.

CHAPTER XXI.

Detachable Crowns.

554. As stated elsewhere, porcelain facings, when subjected to the heat of soldering, are frequently checked, or their color materially changed, during this process. Detachable facings are designed to overcome these difficulties. For the same reasons, porcelain crowns have been devised which, after having been fitted to the metal framework, or cap, and the parts assembled and held in correct relation with wax, may also be removed from position, the framework invested and soldered and the porcelain then returned to place and held by cementation.

The Alexander Crown.

555. This system consists of porcelain crowns of various sizes for adaptation to the ten anterior teeth. These are full contoured and represent the natural teeth, with the exception that the ridge lap or cervical end is beveled at the expense

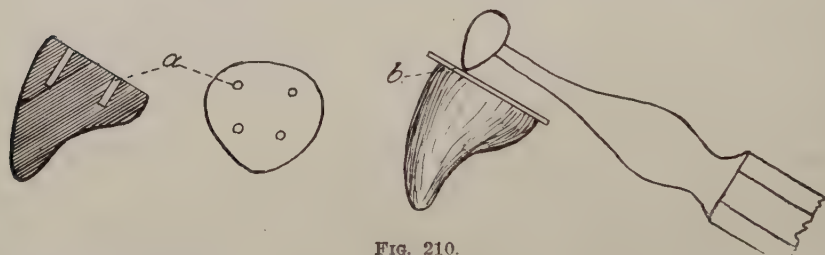


FIG. 210.

of the lingual side. In the base of the crown are from two to four small holes, which enter into the body and run parallel with the long axis of the tooth, to a depth of from two to four millimeters, depending on the length of crown. The method of crown construction is as follows: The cap is made and fitted to the root and the pin fitted and attached as usual, allowing it to project beyond the cap far enough to afford good anchorage in the solder which backs the crown.

An impression and bite are now taken and the case mounted on the lateral motion occluding frame. A porcelain crown of this system of proper length and width is selected and ground to place. The crown, when ground, should touch the cap on the labial or buccal side only, leaving a V-shaped space on the lingual aspect, as in the joint between the cap and crown in constructing a banded Logan.

556. A disc of pure gold is now burnished lightly to the ridge lap and the location of the holes in this surface marked by pressing a pointed burnisher (Fig. 210b) on the surface of the gold opposite them. These indentations mark the point where the holes in the discs are to be punched and into which wires of a diameter corresponding to the holes in the porcelain are fitted and soldered, for anchorage of porcelain to metal base. When the holes have been punched the disc is returned

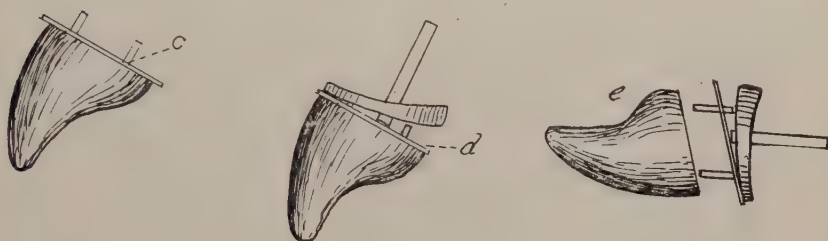


FIG. 211.

to the porcelain and the wires inserted through it to the full depth of holes in the crown. The opposite ends are allowed to project slightly beyond disc.

Wax is now melted on disc and around pins, and these are all removed in proper relation to each other and invested so as to retain this relationship after wax is removed. They are then attached by soldering. The disc now bearing the attached pins is returned to the porcelain and the burnishing continued until the metal is in absolute contact with the crown around its entire periphery (Fig. 211c). In this case, as in all others where two thicknesses of metal are interposed between the face end of the root and the porcelain, the end of the cap and the disc, at their point of contact, should be dressed down by filing, in order to avoid unnecessary display of metal.

557. The crown, with disc, *d*, in place, is set and held in position on cap with sticky wax, and when wax has cooled the porcelain *e* is slipped off, the case invested so as to expose the entire joint, and solder flowed between or into the V-shaped joint previously filled by the wax. When this has been accomplished the piece is taken out of the investment, pickled and cleaned, the porcelain set in place and the dressing down of the surplus metal followed by the final polishing. The crown is held to its base by cement, the pins furnishing ample resistance to lateral stress, and the base, being almost at right angles to line of direct stress, affords all needed resistance to this force. The complete crown is set in the usual manner.

The Underwood Crown.

558. In general appearance this crown is very much like a Logan, except that it has no pin. The attachment is made by means of a disc of thin, soft platinum, attached to which are small pins, which extend into the porcelain (*a*, Fig. 212). This metal base is placed in position before the body is baked, and is, of course, permanently attached to the crown. The pins



FIG. 212.

are located on a line parallel with the mesio-distal diameter of the crown, and should the porcelain require grinding on its base in adapting it to the cap, the platinum disc can be peeled up on the labial, buccal or lingual surfaces, *b*, for this purpose and again conformed by burnishing.

559. To construct a crown by this system the end of the root is faced at right angles to its long axis, the cap constructed with pin extending into root canal, the opposite end projecting slightly beyond the cap. A crown of suitable shape is

selected and ground to place, the idea being to leave a slightly V-shaped opening on the lingual side *c* to facilitate the flowing of the solder. The cap and crown are waxed in position and invested as usual, so as to expose the entire joint, and solder flowed in the V-shaped opening, entirely filling it. The crown is finished and set in the usual manner.

The Davis Crown.

560. This crown consists of a porcelain pinless tooth, the retention of which is secured by means of a hole in the base of the crown, extending into the body of porcelain, which receives the end of the projecting pin in the root canal (see Fig. 213). Where a cap is desired the method of crown construction is as follows: The end of the root is faced and

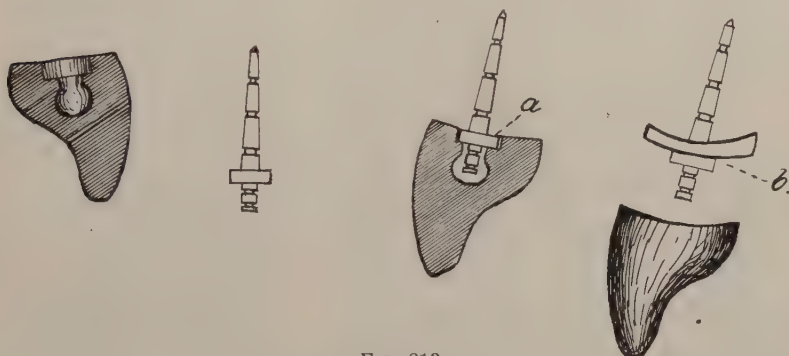


FIG. 213.

cap constructed as usual. The crown is ground to fit the cap, and since the pin is not attached, this is easily accomplished. The hole for the pin is punched in the cap directly opposite the opening in the porcelain, the root canal reamed out and pin fitted into place.

561. The pin which accompanies this crown has grooves cut in it at several points throughout its length to afford better anchorage in the cement. The base of the porcelain is countersunk with a larger opening than that which extends into the body of the crown. This enlarged opening receives a collar on the pin, and by reason of the greater diameter of this shoulder pin, as it is called, better anchorage is obtained, *a*.

The pin is inserted in the opening through the cap and

carried in until the shoulder rests upon it. An impression is taken with these two parts in their relative positions, removed, filled, separated, and cap and pin soldered together, *b*. The cap with pin attached is then set permanently and the crown set upon the projecting end of the pin with some good cement.

562. This crown has been modified slightly for bridge purposes to fit the sockets or cups of the Townsend system, and the combined method is called the Davis-Townsend system of crown and bridge work.

563. Gold cups of varying lengths and sizes are furnished, into which the porcelain crowns are accurately fitted. A shoulder pin corresponding to the end of the one just described is attached to the base of the cup and projects upward, at a greater or less inclination, to enter the hole in the

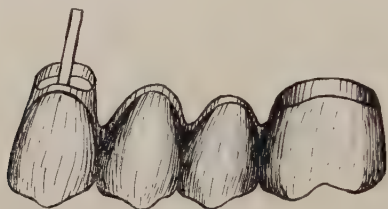


FIG. 214.

porcelain crown. When constructing a bridge by this method the abutment crowns are completed and gold cups are accurately fitted into the intervening space, so that their proximating surfaces are in contact. These are waxed in correct position and crowns of suitable length to meet the occlusal requirements are selected. They should also fit the cups accurately. When all are adjusted and the metal parts firmly united with wax, the crowns are detached, and the metal framework is removed, invested and soldered.

564. The finishing and setting is accomplished in the usual way. In this system the cups are cut out on their labial or buccal surfaces, so as to lessen the amount of gold exposed, and when the steps are accurately carried out very artistic results can be secured. Fig. 214 represents a crown constructed by this method.

The Davis Crown in Bridgework.

565. Under the above title Dr H. J. Combs in the Items of Interest recently gave a brief but excellent description of the application of this crown to bridgework, a synopsis of which is herewith presented in practically his own language: "In order to make this method of bridgework as clear as possible, I select as an example a case extending from the right superior cuspid to the right superior central." Prepare the roots of the teeth as for an ordinary cap crown. Take an impression of the end of each root by pressing base-plate wax against

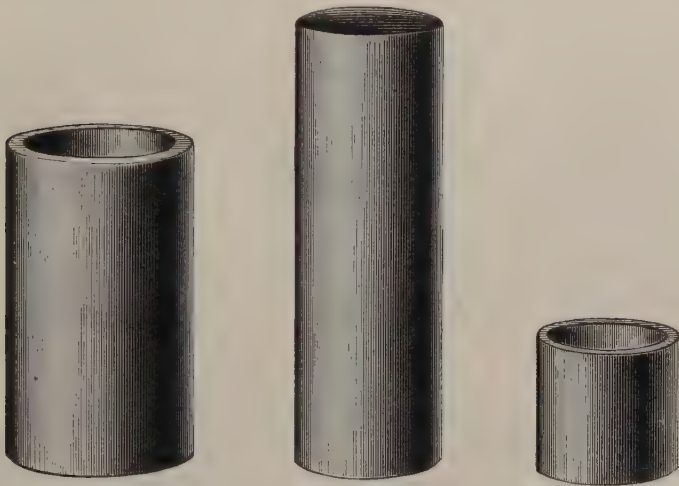


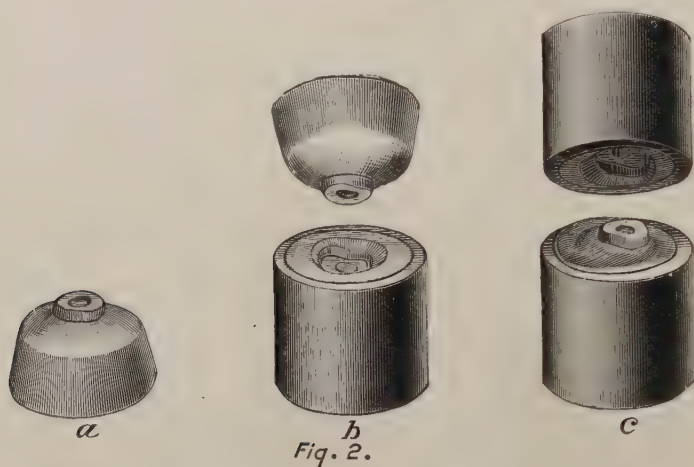
Fig. 1.

it so as to secure an impression of the periphery as well as the face of the root.

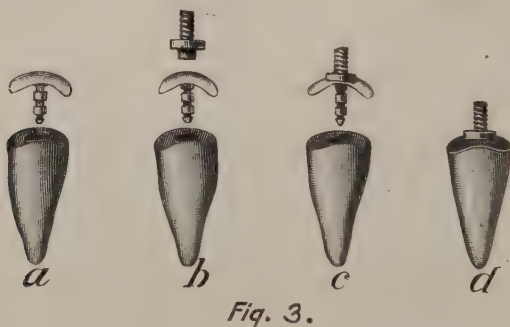
Next, pour plaster into the impression, remove the wax and carve the root to as great a depth as the free margin of the gum will admit the band. A narrow band is preferable.

566. Rub soapstone over the plaster model of the root to prevent the dental-lac into which it is pressed from adhering to it. A die and counter-die are now made from dental-lac, using powdered soapstone to prevent adhesion of the two together in construction, and from sticking to the fingers. If care is taken a perfect die and counter-die may be secured.

These should be made to fit in the ring of a swaging device as illustrated in Fig. 1. The plaster model is shown at Fig. 2 *a*. The counter-die with plaster model just removed (Fig. 2 *b*) and the die and counter-die completed (Fig. 3 *c*).



567. No. 34 or 36 gauge platinum of a size suitable for the cap is placed over the counter-die and swaged, using the swaging device (Fig. 1) with soft vulcanite rubber plunger to prevent the possibility of buckling. It is then placed on the die and swaged to fit the root.

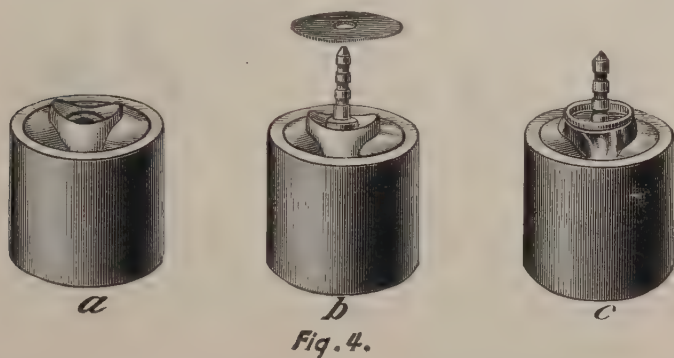


The platinum cap is now placed on the root in the mouth, and if the fit is not perfect it can be made so by burnishing it to the root.

568. Next punch a hole through the cap, insert the post

and solder it in place, (Fig. 3 *a*). This post may be made of platinum, or a Davis crown post may be used by cutting it off just below the shoulder, preserving that part with the shoulder attached, for use in the crown (Fig. 3 *b*), or if the root canals are in proper relation to the holes in the crown, the Davis crown post may be used intact (Fig. 3 *c*).

569. To do this it is necessary to place the caps in position on the roots (Fig. 3 *d*) and fit the Davis post and crowns as nearly as possible. Place a little soft wax over that portion of the post to be inserted into the root and press it to place with the crowns. The bite and impression can then be taken.

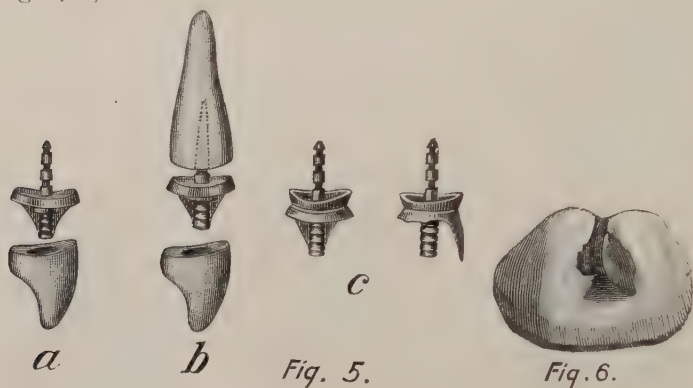


570. To facilitate their removal for separate investment and soldering, run a little soft wax around the post and inside of the caps before pouring the model. Select suitable teeth for the case in hand, grind their cervical, and, if necessary for a perfect occlusion, their occlusion surfaces, care always being necessary to allow for a sufficient thickness of gold to properly support the work when completed.

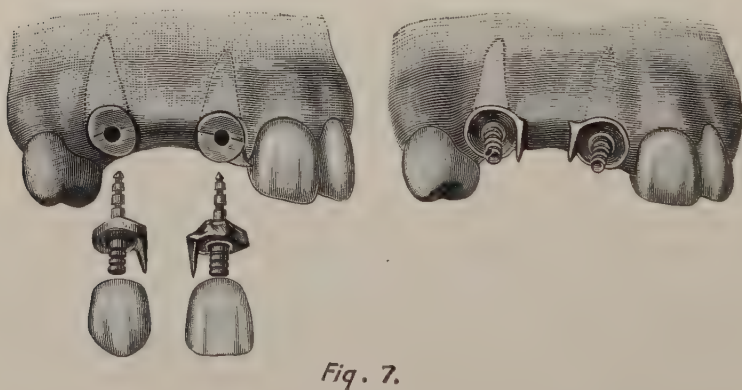
571. In order that the coping may be brought well into the approximal space, the cuspid should be hollowed out on the distal approximal surface. This forms a festoon of gold and allows the solder, used to join the coping, to rest directly on a portion of the cap, adding materially to the strength of the latter.

572. To finish the cuspid, after grinding sufficiently press the cutting edge into the softened dental-lac (Fig. 4 *a*), protecting and holding it firmly while swaging the coping over the cuspid or porcelain tooth. Fit the post, with the shoulder

previously mentioned, into the tooth, being careful to seat the shoulder perfectly into the recess or socket of the tooth (Fig. 4 *b*). For coping, punch a hole through 32 g. 22 k. gold (Fig. 4 *b*), and press it firmly over the protruding portion of the post and tooth, and, with a soft plunger, swage it to place (Fig. 4 *c*).



It may be necessary to slightly burnish the sharp angles in order to secure a perfect fit. The post should then be soldered to the coping (Fig. 5 *a* showing relative position).



573. Care must be exercised that the solder shall not flow beyond the margin of the shoulder of the post inside of the coping. The danger of this may be obviated by a coating of whiting around the marginal line of contact, between the shoulder and the coping.

574. The coping of the cuspid may now be waxed onto the cap (Fig. 5 *b*) and then returned for investment and soldering (Fig. 5 *c*). To invest the abutments after the coping and cap have been waxed together, carefully fill cap and coping with investment material and trim it down until the entire surface of both are exposed to the blowpipe (Fig. 6). If you do not succeed in flowing the solder all over the platinum cap,

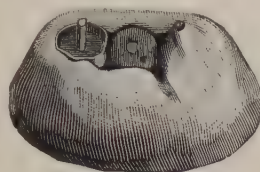


Fig. 8.

it may be easily accomplished after removing it from the investment by holding it in the pliers and flowing more solder over that portion not covered.

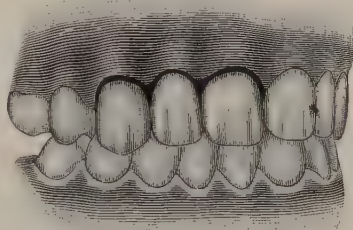
575. Replace the porcelain tooth upon the coping and place on the model (Fig. 7). Both abutments having been finished, the work has now reached the point where the dummies are



a



b



c

Fig. 9.

to be prepared. They are constructed in the manner described for the abutments, the tooth being ground to fit the model and a coping swaged to fit it.

To assemble the teeth for final investment, place a piece of tinfoil over the model between the abutment. This will answer three purposes; to prevent the wax from adhering to the model, to admit of easy removal of porcelain and give

rigidity to the wax which facilitates the removal of the abutments and dummies for final investment and soldering (Fig. 8).

The soldering having been completed, and work finished, the porcelain teeth are then set in place with cement (Fig. 9 *a b c*).

It might be well to suggest that a record be kept of the number of the mold of each tooth used, and, if you should ever be called upon to repair the bridge, you will be glad to find that you do not need to remove the entire bridge and will spend but a few minutes in repairing.

The Brewster Separate Dowel Crown.

This crown consists of a full contoured porcelain crown, in the base of which is baked a rectangular platinum box for

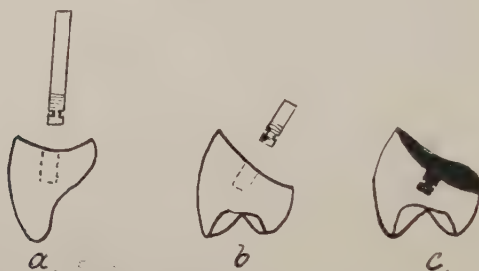


FIG. 215.

receiving an accurately fitted post, by means of which it is retained in position on the root (Fig. 215*a*). Since the post is

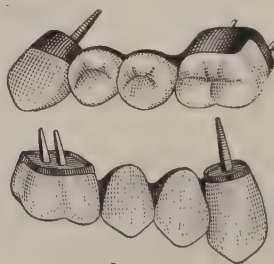


FIG. 216.

detachable, the crown can be readily fitted to the root or cap. When combined with metal, the several parts can be constructed and the crown afterward set with cement,

A modification of this crown is used in bridgework, and is known as the Brewster detachable bridge tooth. Fig. 215*b* shows a bicuspid with short post, which is attached to backing; *c* shows section of tooth and metal parts. The advantages of a tooth of this character are that the display of metal is obviated to a great extent, as in the Davis crown, and in case a facing is broken it can be replaced without removal of the metal framework.

Fig. 216 shows a bridge constructed by this method. It appears that a tooth of this type, if constructed of porcelain which is capable of resisting stress, will prove a valuable aid in bridge construction, from an esthetic point of view.

CHAPTER XXII.

The Construction of Seamless Crowns.

576. The system of seamless crown construction consists in swaging a crown entire, from a single piece or disc of metal. In order to produce crowns of natural shape it is necessary to first carve, in plaster, a model of the exact size and shape of the tooth to be reproduced. This system is not of practical value to those who cannot reproduce in plaster the forms of the natural teeth. Very artistic and beautiful results can be arrived at by those who are capable of producing natural tooth forms and who can carry out the several steps successfully. It is not claimed that more artistic results can be attained nor that better crowns can be produced by this system than in any other way, but under proper conditions it is a useful method and deserves a place in the laboratory.

The Preparation of Roots.

577. The preparation of roots for shell crowns of the seamless type differs in no material respects from that followed where the ordinary shell crown is to be constructed. After the measurement of the root is taken the steps vary considerably. The wire measurement having been secured, it is cut opposite the twist and straightened out. A piece of copper plate the same gauge as the gold or platinum which is to be used in the crown is cut to exact length of measurement and of the same width as required for the band of a shell crown on the same root. The ends are brought together in the usual manner and soldered, forming a band. This is now fitted to the root, cutting it out mesially and distally to give it the proper bucco-lingual curve, thereby avoiding encroachment on the alveolar process.

578. The same care and exactness must, in fact, be exercised in fitting this band as is required in fitting an ordinary gold band for a shell crown, since the copper band establishes

the curve and gingival contour, and, when filled with plaster and carved, indicates the length of the completed seamless crown. When the cervical fitting has been properly accomplished and the band cut to correct length, occlusally, the buccal and lingual portions are then cut out as shown in Fig. 217c. The two projecting points *d* and *e* should be left well toward the buccal embrasure, as these are to be bent so as to form the points of proximate contact with the adjacent teeth. The band is now returned to the root for a bite and impression. Usually an accurate modeling compound bite is all that will be required. This is mounted on the occluding frame in the usual manner by filling each side with plaster and attaching to the upper and lower bows of the frame. When the plaster has set, separate by heating the compound.

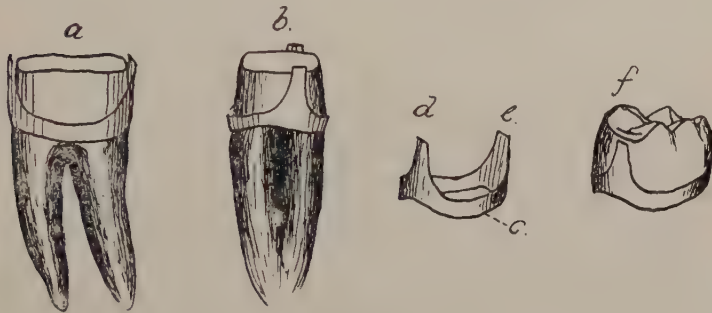


FIG. 217.

579. The plaster teeth opposite the band are now covered with a film of separating medium, the band filled with plaster of medium consistency and the frame closed, bringing the teeth on each model in absolute contact. This forces the plaster out on buccal and lingual sides and secures an accurate impression of the occlusal surfaces of the opposite teeth. When plaster has set, the frame is opened and the case is ready for carving.

580. First give the proper buccal and lingual contour to the body of the crown. The band having been cut out on these surfaces, it is necessary to carve, in the plaster, the general contour of the sides. The occlusal surface is carved in the same manner as in ordinary carved cusp work. Develop the central groove first by making a V-shaped cut en-

tirely through the occlusal surface from mesial to distal sides, yet not so deep as to obliterate the general surface markings or destroy all the contact points of this surface with the opposite occluding teeth. The various developmental grooves should then be laid in, in proper position, corresponding to the tooth to be carved.

581. In carving any cusp the idea is not to retain absolute surface contact with the opposite teeth. Four or five points of contact, uniformly located on the occlusal surface, will insure a sufficiently good occlusion and render better service than if these contact points were quite broad. The lines and grooves should be distinct, the planes of the cusps well defined and the triangular and marginal ridges prominent as possible in order to insure good surface markings on the crown. These are the points which give character and individuality to any tooth, and should under no circumstances be indefinitely developed. It is better to exaggerate their prominence, to a slight extent, in the model, in some cases, since in swaging, some of the original sharpness is lost in the grooves of the occlusal surface by the battering down of the high lines in the matrix. It is impossible to deface cusp surfaces in the matrix to any extent, since these are depressions instead of points; Fig. 217f shows lower first molar carved ready for casting matrix.

582. The tooth having been carved to proper outline, it is removed from the model on the occluding frame, preparatory to casting the matrix, or counter-die. On the under side, or cervical end of the pattern, a small hole is drilled, extending about half way from this end to the occlusal surface, and into this a peg of wood is fitted tightly, letting the projecting end extend beyond the plaster about four or five millimeters. This affords an anchorage for holding the plaster tooth in position during the casting of the counter-die. A piece of moldine is flattened out, so as to make a slab four or five centimeters in diameter, or broad enough to afford the cast-iron ring in which the matrix is cast a firm foundation on which to rest.

583. The model is now grasped in a pair of automatically closing pliers, the Melottes metal is melted in a small, deep ladle and the plaster crown immersed in the molten metal. Im-

mediately upon being covered by the metal, vibration will be distinctly felt in both plier and ladle handles, and this will continue until all gas and moisture has escaped from the plaster. If the precaution is not taken to drive off all moisture in the model before attempting to cast the counter-die, the matrix will be of uncertain density and, in nearly every case, be very imperfect. The metal should, of course, be kept in molten condition and ample time given the moisture to escape. Three or four minutes' time is usually sufficient to free the model from all volatile matter. The principle involved is this: By subjecting the plaster tooth to the same condition met with in casting and expelling all moisture in this preliminary step, and thus removing the cause of failure, the casting of the counter-die may be successfully accomplished.

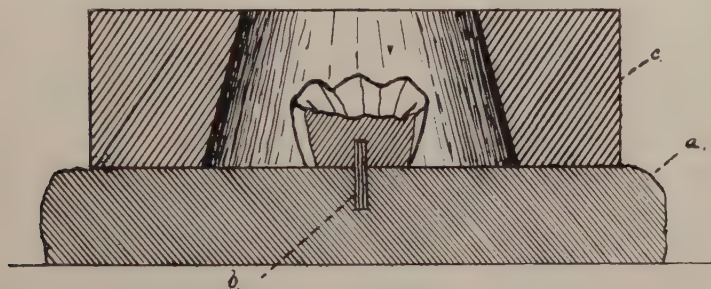


FIG. 218.

584. When all vibration in the plier handle has ceased the model is removed and placed on the base of moldine, occlusal end up. The moldine should be covered with a sheet of thin paper, in the center of which a small hole has been made, and through this opening the wooden peg projecting from the model is passed and the model pressed down until its cervical end is in close contact with the paper which covers the surface of the moldine base.

585. Care should be taken that the band is not forced below the level of the upper surface of the clay, since, if this occurs, the crown, when complete, will be correspondingly shortened. The ring is now placed over the model and pressed down until its inner periphery is in close contact with base. Fig. 218 shows sectional view of ring and model in position. Into the slots in the ring are fitted pieces of cardboard, extending toward the model and approaching it within two or three millimeters (Fig.

219). These are to weaken the die so that it may be more readily split apart, and in placing them in the slots previous to casting they should be set as nearly across the greatest diameter of the model as possible.

586. The case is now ready for casting the counter-die. The metal should be as cool as it is possible to pour it and should be poured slowly on the occlusal surface and allowed to trickle down the sides of the model, gradually filling the interior of the ring and covering the model to a depth of four or five mm.

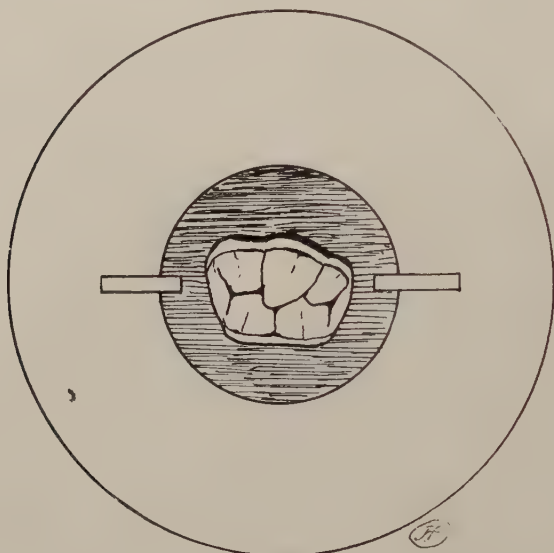


FIG. 219.

over its occlusal face. When cool, the ring is lifted off and the counter-die knocked out, the cardboards are removed from the slots, the blade of a knife or some wedge-shaped instrument inserted into the slot and tapped with a hammer to split the matrix apart. The plaster model is then removed, usually by breaking away in pieces, the interior of the counter-die is oiled, the two halves are fitted together and the matrix examined to see that it is perfect. Fig 220 shows one-half of the counter-die

Constructing the Thimble.

587. In addition to the casting ring already mentioned, there is another appliance for constructing the thimble, or cap,

of metal from which the crown is to be swaged. This is really a modified form of a draw plate, with a series of accurately graded holes of decreasing size, accompanied by steel mandrels of correspondingly decreasing sizes to fit the holes. These mandrels, however, do not accurately fit their respective holes, being turned down to a smaller diameter or reduced to the

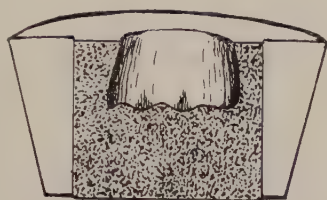


FIG. 220.

equivalent of two thicknesses of the plate which it is designed shall be used in the crown. The holes are turned somewhat larger at the end which receives the disc of metal, in order that it may be more readily centered (see Fig. 221*a*). The lower end is also more open than the central portion, to allow the thimble to drop out without difficulty (*b*).

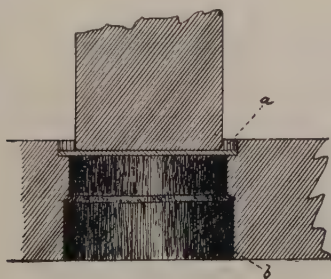


FIG. 221.

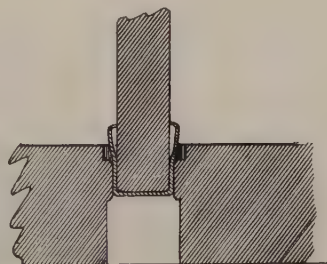


FIG. 222.

The holes and mandrels should be oiled before beginning to conform the disc over the mandrels. The disc for molars is placed in the largest hole, the mandrel corresponding to that hole is evenly centered over the disc and its end struck a light, firm blow with a hammer of medium weight. If the die plate rests on a solid foundation one blow will be sufficient to carry the disc through. It is then placed in the hole next in size and

carried through that one with the corresponding mandrel, and this process is continued until the thimble is of a diameter approximately equal to that of the matrix. Fig. 222 shows a thimble being carried through a smaller hole.

Thimbles of all ordinary sizes may now be procured at the supply houses at practically the cost of the material contained.

Swaging the Crown.

588. The fusible metal counter-die is now separated, the thimble placed between the two holes in the matrix and the counter-die returned to the cast-iron ring. A piece of pine about four inches long is trimmed to a size corresponding to the interior diameter of the thimble, into which it is inserted, and with light uniform blows from a six or eight ounce hammer, the metal is carried or driven down into the bottom



FIG. 223.

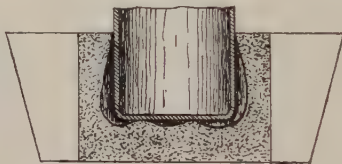


FIG. 224.

of the matrix. The counter-die should occasionally be removed from the ring and separated to see how the swaging is progressing. Fig. 223 shows thimble; Fig. 224 sectional view of thimble in matrix.

589. If there is considerable swell to the sides of the matrix it is frequently a good plan to fill the interior of the partially swaged crown with modeling compound (using it cold), breaking it up in small pieces and forcing it in until entirely full. This is then packed solidly into the interior with a stick of wood, which has been accurately fitted to the opening in the crown. Under repeated light blows the compound spreads laterally and conforms the metal to the sides of the matrix. As a rule, the characteristic points of the cusps and marginal ridges cannot be brought out distinctly by the means already mentioned, but can readily be developed by using a pointed stick of hickory, lignum vitæ or maple. If, before beginning the swaging operation, the coun-

ter-die has not been oiled, the metal will most certainly be torn while being forced into the matrix. This precaution must under no consideration be neglected.

590. When, in conforming the crown, it becomes necessary to anneal it, the base metal should first be carefully removed by polishing with pumice stone and stiff brush, to prevent contamination of the gold or platinum by the counter-die alloy. When the crown has been perfectly adapted to the sides of the matrix the surplus portions that have been battered down to a greater or less extent over the cervical margin of the matrix should be accurately trimmed to this margin. If the counter-die has been properly constructed this margin will give the exact curvature to the cervical end of the crown.

If the copper band has been properly fitted to the cervix of the tooth and allowed to extend under the free margin of the gum the correct depth, the completed crown will take a similar position when so set, requiring but little if any fitting at this point.

591. It has been urged against the seamless crown that the cervical portion, owing to the fact that it has been crimped or drawn through the die plate, is not so strong nor resistant to stress as bands made from ordinary plate, and that a seamless crown will yield under stress in the mouth. There is perhaps some truth to the first proposition, and we will accept that criticism.

The second, however, has not been substantiated, as the writer has not seen a single crown constructed by this method yield to stress when properly set. In ordinary shell crowns we do not depend upon the extreme cervical margin of the band for retention purposes, but rather upon the whole interior surface, which, being filled with cement or gutta-percha, surrounds the root, or post in the root, and thereby cements the entire crown to its anchorage.

Should it be deemed advisable to strengthen this portion of the crown, it can easily be done by flowing a thin film of high-grade solder around the cervical periphery. The cusps must, of course, be filled in with solder, to stiffen and support the occlusal surface, the same as in ordinary crownwork.

592. To construct these crowns properly requires a high

order of skill, and the prosthetist must be an artist in the true sense of the word, but this is no objection to the method. Does it not require a high order of skill and ability to place a gold filling, with perfect margins and uniform density, in a tooth, or to restore contour and proximate contact to the lost portions of teeth? Yet all strive for this skill or ability, and many attain it, to a greater or less degree, and consider that they have only done what the requirements of the profession demand. So in prosthesis, this branch should be given the same amount of attention, careful study and thought as is given the operative branch, and any method that enables the prosthetist to construct crowns which will fulfill the requirements of usefulness and esthetic conditions to the best advantage should be thoroughly studied and its details mastered.

593. Recently a number of devices and appliances have been placed on the market, several of which are very ingenious, and yet simple, for constructing seamless crowns. The details differ somewhat with each device, but as the fundamental principles involved are similar to those given in this chapter, the minute description of the several systems will be omitted.

The radical point of difference to be noted is that in some of the systems mentioned a reproduction of the crown to be made is carved in plaster, or a natural tooth may be used as a model. From this a plaster matrix is secured, into which Melottes metal is run, thus forming a die, over which the crown is swaged. A thimble of gold, of proper size, is selected and fitted to the die.

594. This is then placed in a cone-shaped swaging device and pressure exerted to compress the surrounding swaging medium, thus forcing the thimble into close contact with the die. Usually lead is used for the swaging medium, although Melottes moldine, or any putty-like substance that can be properly confined, may be used for this purpose.

595. The die is removed from the swaged crown by placing in boiling water, which fuses the metal and prevents contamination of the gold by the baser metal, as would occur if melted out by dry heat. Crowns swaged by this method are as much larger than the model as the thickness of the gold, and therefore allowance should accordingly be made in carving or selecting a pattern tooth.

CHAPTER XXIII.

Repairing Crowns and Bridges.

596. Where crown and bridge work is extensively, or only moderately, practiced, more or less trouble is experienced from porcelain facings breaking or the metal framework giving way under the stress of mastication. If more care and study were given to the subject of stress exerted by the muscles of mastication in partial as well as full occlusion, many accidents that ordinarily occur along this line would be obviated. Since accidents are of frequent occurrence, various methods of repairing must be resorted to, to overcome the difficulty.

One of the most common accidents met with is the fracture of a porcelain facing on a bridge. When such fracture occurs the best method of repairing consists in removing the substitute, sawing out the old backing and replacing with a new facing and backing. When this method is decided upon the steps are as follows: An accurate bite and an impression is taken, with the bridge in position on its abutments. The bridge is then removed, boiled in acid to remove all organic matter and any cement if present.

597. The removal of the cement is an imperative necessity and should under no circumstances be neglected. If allowed to remain, the oxide of zinc in contact with gold is, under the heat of the blowpipe, apparently resolved into metallic zinc. When present, therefore, a low alloy is formed, which fuses at a lower temperature than the solder, and the result is that portions of the metal framework will be fused or burned during the soldering process, oftentimes necessitating the entire reconstruction of the piece.

598. After thorough cleansing, the bridge is replaced in the impression, the latter filled, separated, the bite placed in position and the case mounted on the occluding frame. The backing of the fractured facing is sawed out with a fine-tooth

saw, a facing of suitable size and color is selected and ground to place, and the backing adapted to it. The two ends of the bridge are carefully removed from the model, mutilating it as little as possible, the plaster is cut out of the caps, and the parts returned to position on the model. The facing is then fitted into position, the parts all waxed firmly together, and, when wax is cold, removed and invested for soldering. No special directions are necessary, as this step, as well as the finishing of the piece, is similar in most if not all respects to that followed in bridge construction proper.

599. When the facing on a crown is broken, the cap should first be removed, the old backing sawed off, so as not to weaken the pin attachment in the base (see Fig. 225, dotted line *a*), the gold on the labial half of the cap thinned down by grinding, to less than one-half the thickness of 29-gauge gold, *b*. The cap

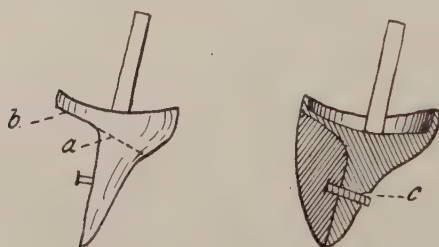


FIG. 225.

is then placed back upon the root and an impression and bite taken, and the case mounted on the occluding frame. A facing is selected, ground, backed and waxed in position and the crown removed, invested, soldered, and finished in the usual way.

600. Cases, however, present themselves in which for some reasons it is not deemed advisable to remove the old backing. When this is the case the bite and impression are secured, the bridge removed and placed in the impression, which is then filled and mounted on the occluding frame. The old pins are now cut away and a facing selected for the case. A film of wax is flowed over the surface of the old backing and the pins are pressed into the wax, thus marking the location where the holes are to be drilled. The facing is now ground to place and when properly fitted is backed with 36 to 40 gauge platinum

plate or foil, if it seems necessary, allowing it to extend well beyond the incisal end, and the angle formed by junction of ridge lap with lingual surface of facing. Wax is flowed over the backing, and while quite soft the facing with backing in place is pressed against the old backing. The softened wax is forced out around the margins, but its presence insures the close adaptation of the platinum plate to the porcelain during the investing process.

601. The case is now invested in such a manner as to protect the porcelain from the flame, and yet so as to leave the incisal and cervical joints open. Flux is applied, the solder placed in position and case heated and soldered. The holes in the old backing in which the pins are fitted should be waxed over their lingual ends to prevent the ingress of the investment, so that the solder may be drawn through and attach the pins throughout their entire length. The finishing of the case is accomplished as usual. A low grade or an easy flowing solder should be used when repairs of this nature are made.

Repairs Without Removal.

602. The most simple and common replacement of a facing without removal of the piece consists in cutting away the old pins, selecting, grinding and fitting a facing to place very much the same as just described.

The lingual ends of the holes in the old backing are slightly countersunk, *c* 225, and the platinum pins in the facing are cut off, if too long, until they project but slightly beyond the surface of the backing. A piece of lead weighing six or eight ounces is shaped into a cylinder and one end drawn down to a point, the area of which about equals that of the facing. The back of the porcelain is covered with cement and carried to place, the lead point set against the labial face, and the pins are riveted with a square-ended plugger and hand mallet, or with such a point in the automatic mallet.

603. The method of bending the pins tightly against the backing and grinding away the surplus is sometimes resorted to, but is not satisfactory, as, under stress, the pins bend and the facing becomes loosened.

Care should be taken to use a drill of as nearly the same size as the diameter of the pins, in order that the thickening

of the pins, which will occur if the riveting is properly carried out, may reach the sides of the holes and give more stability to the piece.

The Brewer riveting forcep is designed for riveting the pins of facing in such cases, and while not universal in application, is very useful in most instances where repairs of this character are deemed advisable.

The Bryant System.

604. A method of repair, designed to hold the facing more firmly in position than the ordinary methods usually do, is the one known as the Bryant system. This consists in attaching the porcelain to the old backing by means of small nuts, which are fitted to the pins. Several special tools are needed for this

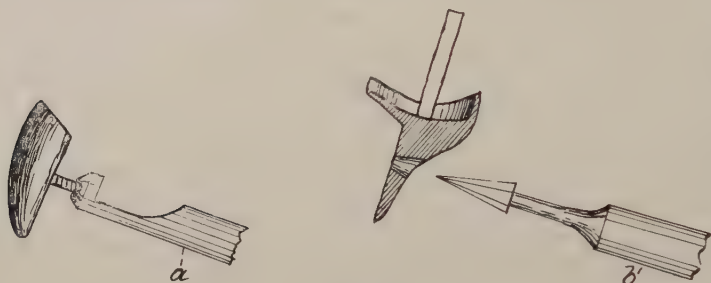


FIG. 226.

work. Two taps, one of which cuts a partial, the other a full, thread, are used for threading the pins (*a*, Fig. 226). A small tapered reamer is used for regularly enlarging the lingual ends of the holes in the backing, *b*. A screw-driver (Fig. 227*c*), with a slot in the middle of the blade to admit the pin while carrying the nut in place, accompanies the taps, and, lastly, taper nuts *d*, corresponding to the taper of the reamer, and threaded to receive the platinum pins, complete the outfit.

605. The method of repair is as follows: The old pins are cut away, a facing selected and holes drilled to correspond to pins. The facing is then fitted into position by grinding at such points as prevent a close adaptation. The pins are then threaded and the lingual ends of the holes are reamed out to admit the nuts. The lingual surface of the facing is then covered with cement and the porcelain forced into position against

backing. A sliding thimble *c* on the end of the screw-driver receives the nut, and this is then quickly carried up to position and into place on the pin. The other one is also quickly set before the cement has hardened. When set the surplus cement is trimmed away and the projecting ends of the nuts dressed down with a small engine stone and polished with discs. In

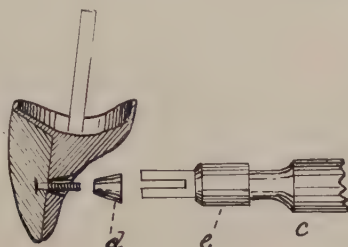


FIG. 227.

cutting the threads on the platinum pins they should be kept oiled and the die gradually rotated, being especially careful not to twist the pins off—an accident very liable to occur. This method is productive of good average results, but is not as satisfactory as a repair made by soldering. Fig. 228 shows complete set of instruments in this set.

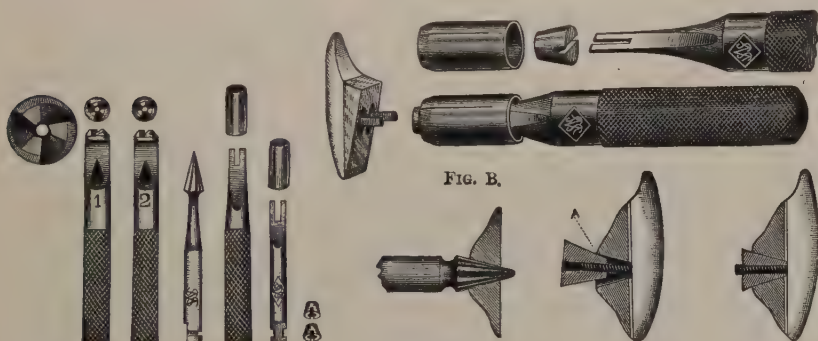


FIG. B.

FIG. 228.

606. Another method recommended by Dr. Griswold is by slotting the backing, cutting the slots the same distance apart as are the pins, and extending them from the point which they occupy when the facing is properly located, down to and through the incisal end of the backing (Fig. 229). The central section of the lingual surface of the backing is now ground

slightly to reduce its contour. A small piece of pure gold is punched with holes coinciding with the pins and is slipped over them (Fig. 230a). The facing is then placed in position by sliding the pins upward in the slots until it is properly located. The piece of gold plate is then burnished closely to the backing, and an impression of the lingual surface of the back-



FIG. 229.

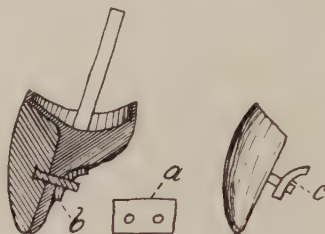


FIG. 230.

ing, the ends of the pins and the plate taken and filled with investing material. The impression is then removed and the plate soldered to the pins *c*. This forms a loop which accurately fits the middle section of the slotted backing. The facing is thus held in position by the loop and with cement.

Repairing Shell Crowns.

607. When openings occur in the occlusal surfaces of bicuspid or molar crowns they may often be repaired by adjusting the rubber dam, shaping a cavity corresponding to the opening in the gold and inserting a gold filling. This will exclude the fluids of the mouth and prevent decay, while in appearance the difference in the shade of gold is not perceptible. This method obviates the removal of the crown. The removal of a shell crown is easily accomplished by drilling a hole just under the cap and through the cement, to, but not through, the opposite side.

608. A steel rod or the shank of an old broken instrument is inserted in the opening and the end carried well against the opposite side. Under pressure, the end of the root is used as a fulcrum, the weight is represented by the crown and the power by the pressure on the handle. The side of the tooth opposite the hole should be supported by pressure when force is brought upon the handle of the instrument to prevent side stress upon the root. This method permits the ready removal

of the crown without serious mutilation, the opening being readily repaired by waxing the hole from the outside even with the inside of band, filling crown inside with investing material, removing wax, fitting in a piece of plate to fit opening and flowing solder over joint.

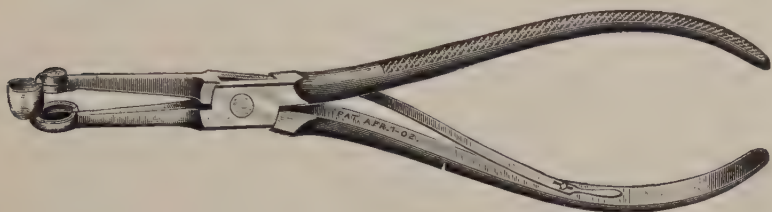


FIG. 231.

Fig. 231 represents a *crown splitter*, which can be used for slitting a crown in case it cannot be removed in the manner described.

In all cases of repair a careful study of the conditions will enable one to decide what plan can be followed to insure the best results.

CHAPTER XXIV.

Porcelain Crownwork.

609. From an esthetic standpoint the replacement of the crowns of the natural teeth, when lost through accident or by disease, can be best accomplished by means of *porcelain* substitutes. In addition to the various classes of porcelain crowns furnished by the manufacturers, from which the prosthetist can select as each individual case demands, the method of *constructing* crowns of this character has been followed for a number of years and has gradually grown in favor until, at the present time, it is considered the most satisfactory from the standpoint of both esthetic requirements and utility.

Indications for Use.

610. Porcelain crowns can be placed in any location in the mouth where proper root preparation can be accomplished, and the crown, when constructed, will have sufficient bulk to withstand stress.

611. Experience has demonstrated that when occlusal stress is heavy a space of at least five mm. should exist between the face end of the root being crowned and the incisal or occlusal surfaces of the teeth in the opposite jaw, to give the necessary bulk to the porcelain. Crowns placed in a more limited space than that specified will usually prove unsatisfactory from the breaking of the porcelain under continued stress.

612. *Porcelain crowns* are more translucent and, therefore, more nearly resemble the natural teeth than do those in which facings are combined with metal backings. They can be so constructed as to entirely obscure the metal band encircling the root, even though absorption or recession of the gingival margin of the gum should subsequently occur.

613. For esthetic reasons, therefore, porcelain crowns can and should be placed in many locations in which the so-called Richmond crowns are now used.

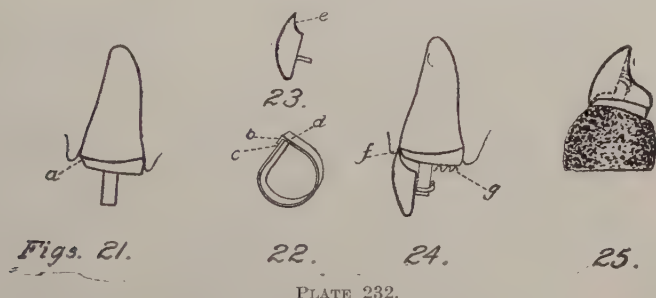
Crowns of this class are constructed in various ways. The methods most commonly followed will now be briefly described.

The Banded Porcelain Crown.

614. When conditions are favorable for the use of porcelain, the root canals of the teeth having been filled, the next step in the root preparation will be the removal of any remaining portion of the natural crown. The root should not be faced below the free margin of the gum at any point, until the enamel is removed, the root given its correct peripheral form, the measurement taken, and the band soldered and fitted. The several steps mentioned are carried out in the usual manner and in the order named.

Constructing the Band.

615. The band should be constructed of 29 or 30 gauge *iridio-platinum* to obviate its stretching in those cases in which the substitute will be subjected to considerable stress. In



ordinary cases *platinum* of the gauge mentioned can be used, as it can be more easily and perfectly adapted to the root. The strip of platinum for the band should be cut slightly longer than the exact root measurement to allow for a *lap joint*, so that in baking, the joint will not open, as often occurs in butt joints. If high-grade platinum solder is used, but little, if any, tendency of the joint to open is noticeable, since this is not dissipated in the furnace at the baking temperature, as is pure gold.

616. Bend one end of the strip of platinum at right angles *b*, turning over the exact amount of surplus allowed. The end *c* is passed under the bent portion and butted tightly against the opposite side at *d*, and soldered. The band is then placed on a round mandrel and the joint tapped lightly with a hammer

until the angle is destroyed, but care should be taken not to stretch the band. The lapped portion can be reduced to the proper thickness with a file or engine stone.

Fitting the Band.

617. The band is fitted in precisely the same manner as those for porcelain-faced crowns, scribing and trimming the cervical end until the entire periphery touches the gum at the same time, when it is driven into position on the root. The incisal or occlusal end is then marked the correct length, the band removed, cut and returned to the root for final adjustment.

618. The root is now faced down to correspond with the completed band, the outer third of the labial or buccal margin of the root beveled under the free margin of the gum to about the point of termination of the cervical margin of the band.

The band is then thinned by grinding on its labial or buccal surface, over the area corresponding to the beveled portion of the root, care being taken to leave the extreme cervical margin full thickness. It is then returned to the root and the thinned portion beaten down against the beveled portion of the root, with a square end plugger in the automatic mallet or with the contra-angled burnisher.

Constructing the Cap.

619. A disc of 30-gauge iridio-platinum plate is cut and burnished to the band, being careful to secure absolute contact of the disc with the band at all points. The fitting of the joints in this part of the work should be as nearly perfect as human skill can make them, for the cap is the basis on which the superstructure is to be built. If this is imperfect the completed crown will be imperfect.

620. The hole for the pin is punched in the cap in the same relation to the labial or buccal surface as for ordinary crowns, i. e., far enough to the lingual to prevent the pin from interfering with the facing. Round iridio-platinum wire, 16 gauge, is used for the posts of cuspids and upper centrals, and 17 or 18 gauge for upper laterals and lower incisors, also, where two posts are inserted in bicuspid roots.

621. Crown posts should extend apically from the cap a

distance equal to the length of the crown to insure stability under stress.

The cap, when completed and the post attached, is returned to the root for final adjustment, the bite and impression taken, and models mounted on the occluding frame.

Selection and Grinding of the Facing.

622. A facing slightly lighter in color than the natural teeth, yet consisting of the proper basic colors, is selected, because when thickened by the addition of porcelain on the lingual side, facings, as a rule, become more opaque and slightly darker.



FIG. 233.

623. The ridge lap is ground out hollow so as to obviate contact of the facing with the platinum at all points except at the extreme labial or buccal margin, which at this point should be thin and delicate so that this margin of the completed crown will be thin, smooth and non-irritating.

624. The pins of the facing are flattened slightly to present a broad surface bearing of the pins against the post. The facing is waxed in position and the crown invested for soldering.

625. After the removal of the wax the pins are bent in absolute contact with the post and small pieces of platinum

solder applied exactly where they are needed, the case heated up thoroughly, base first, and the solder flowed. The small alcohol blowpipe shown in Fig. 233 can be used for this work, ample heat being furnished for this purpose. When soldered and cool the investment is broken away, the skeleton crown thrown into the acid bath, pickled, removed, and thoroughly washed, when it is ready for the application of the porcelain body.

Application of the Body.

626. Crowns of this character can be most conveniently handled by setting the post in a pin vise. A small quantity of moist body is taken up on the point of the spatula and placed on the end of the cap close to the facing. Some serrated instrument is then drawn across the pin vise, thus producing a vibratory motion which settles the granules closely one upon the other and forces out the water, which is taken up with linen napkins or bibulous paper.

627. Frequently the general contour of the crown is developed in the first application of the body. As considerable shrinkage occurs in baking, a second, and sometimes a third and fourth application, is necessary to give the crown, when completed, its proper form. The steps of baking will be considered under bridgework.

Modification of the Banded Baked Porcelain Crown.

628. A serviceable and easily constructed bandless crown can be made for any of the anterior teeth by grinding the root to bi-bevel form (Fig. 234*a*), inserting a post in the canal, to which a disc of platinum has been attached, and adapting the latter closely to the end of the root, trimming the periphery of the disc to coincide with the root outline.

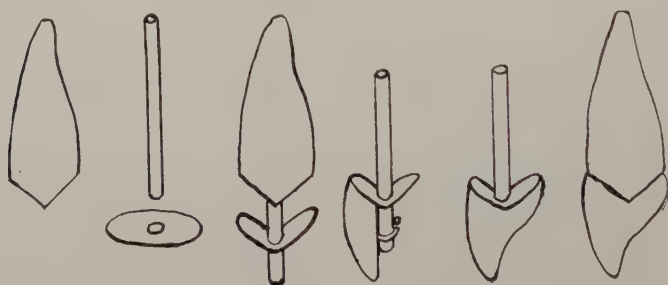


FIG. 234.

629. A facing is then selected, ground and attached by soldering, after which the body is applied and baked. To obviate the bluish tinge imparted to the porcelain by the platinum, the labial half of the disc is sometimes removed after the porcelain has been baked.

The Half-band Crown.

630. This crown consists of a band encircling the lingual side of the root, with disc covering the entire face end of root.



FIG. 235.

The band affords resistance to outward stress, and therefore this form of crown is more particularly adapted to the six upper anterior teeth (see Fig. 235).

The Jacket Crown.

631. This crown was one of the first introduced by Dr. C. H. Land, and is known as the "Land Jacket Crown." It is more especially adapted to those cases where it is deemed advisable to crown the teeth without devitalizing.

632. In one class of teeth it is especially indicated, namely, the peg-shaped laterals so frequently met with, in which it is never advisable to attempt the reaming out of the canal for the insertion of a post on account of the uncertainty in size and form of the root.

Preparation of the Tooth.

633. The labial and lingual sides of the crown should be dressed down to allow for the walls of platinum and porcelain that are to cover these surfaces; the mesial and distal surfaces are also reduced to a taper so as to permit the ready removal of the jacket.

Construction of the Jacket.

634. A band long enough to extend from under the cervical gum margin to the extreme incisal end is formed, scribed, and

fitted to the tooth. The labial and lingual sides are then cut out even with these portions of the beveled tooth surfaces, leaving them attached to the main band near the cervix. The mesial and distal surfaces of the band are then bent in close contact with these surfaces of the tooth. The lingual side is then adapted to the side pieces and tacked with solder, the labial

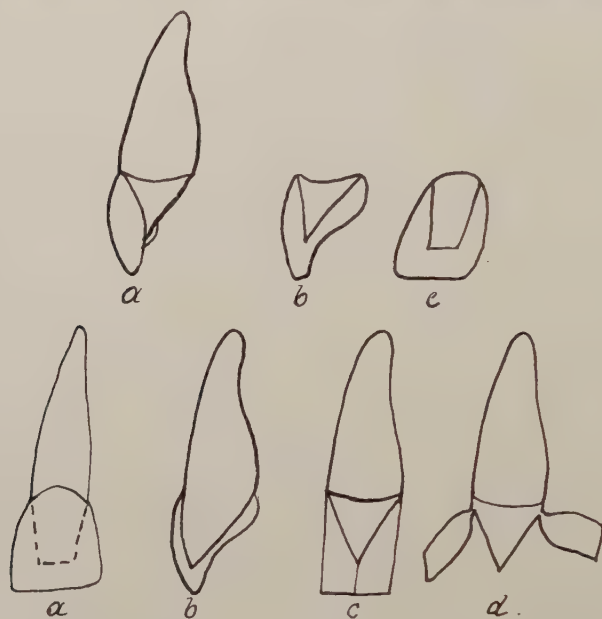


FIG. 236.

piece of platinum is bent back and adapted and soldered to the sides. Then all of the surplus is cut away with engine stones until of uniform thickness.

635. A facing is selected and ground, and the pins bent so as to support it in position during the baking of the piece. Sometimes the pins are entirely ground away in fitting, and in such cases the piece must be so placed in the furnace that gravity holds it in position while vitrifying the porcelain.

CHAPTER XXV.

Porcelain Bridgework.

636. Porcelain bridgework, when placed in well-selected locations, fulfills to a higher degree the esthetic requirements that should be observed in bridgework than any other class or combination of materials.

Application.

637. It can be stated as a positive fact that most of the failures recorded against porcelain when used in this connection are due to its application in unsuitable cases. There are certain conditions often found in the mouth that preclude the introduction of a bridge of this character.

638. Porcelain is strong only in bulk. In thin, attenuated plates it is friable and breaks readily under stress. The truss or platinum framework must be depended upon primarily to furnish the necessary strength to resist stress. A truss may be constructed that fulfills this requirement and the case still be unsuitable for porcelain if the remaining space not occupied by the metal framework is so limited that the porcelain will be spread over the framework in thin layers, especially on occlusal surfaces. The constantly repeated force directed against the cusps of porcelain in mastication will fracture and break them away from the truss, even though the latter may be rigid enough to retain its form.

639. In addition, therefore, to having sufficient space for a rigid truss, there must be sufficient additional space remaining to apply the porcelain in ample bulk to resist stress. It is impossible to state just how wide this space should be. A great deal depends upon the habits of the patient, the amount of force exerted by the muscles of mastication, the length of span and the number and position of abutments and piers.

640. It may be stated that as a general rule there must be a minimum space of at least 5 mm. between the alveolar border

and the occlusal surfaces of the opposite teeth in short spans, while longer spans will naturally require more space, since the truss itself must be more bulky.

641. The length of span is a matter of great importance and should be closely studied. In long spans, where much curvature in the bridge will be required and where only two abutments afford support, a porcelain bridge would most certainly prove a failure. If, however, there is an intervening pier, with sufficient space to insure bulk of porcelain, the case would be suitable for an appliance of this character.

642. The points to be carefully observed and studied are:

First.—The number, position and condition of the roots or teeth that are to serve as supports for the bridge.

Second.—The length of span to be covered by the truss.

Third.—The space existing between the alveolar border and the occlusal surfaces of the opposite teeth.

Fourth.—The habits of the patient as to the care of the teeth.

Fifth.—The amount of force exerted by the muscles of mastication.

Sixth.—Study carefully whether a substitute of any other character might be equally as, if not more serviceable, than porcelain.

Porcelain Bridge Construction.

643. The construction of a porcelain bridge consists of several distinct steps, each carried out in its proper place and may be arranged in the following order:

First.—Preparation of the abutment or pier roots or teeth.

Second.—Construction of caps and shell crowns for same.

Third.—Taking bite and impression and mounting models on occluding frame.

Fourth.—Locating position of, constructing and soldering saddle to caps and crowns.

Fifth.—Locating position of and fitting truss bars in position.

Sixth.—Investing and soldering same to caps and crowns.

Seventh.—Attaching facings to framework.

Eighth.—Application of body.

Ninth.—Baking.

Tenth.—Finishing.

Eleventh.—Setting the bridge.

Preparation of Roots or Teeth.

644. The preparation of the roots or teeth for the reception of caps and crowns which are to serve as abutments and piers for bridges differs in no essential particular from the instruction previously given under the heads of *porcelain crowns* and *shell crowns*, therefore it is unnecessary to enter into the details of this procedure here.

Construction of Caps and Shell Crowns.

645. When the abutment and pier crowns are to be of porcelain the construction of the caps is similar or identical to the methods outlined under the head of porcelain crowns.

646. When platinum shell crowns are constructed for the bicuspsids or molars, as is frequently advisable, the details differ in a few essential particulars from the methods followed in ordinary shell crown construction.

The cusps of crowns, when platinum is used, are more difficult to swage in this material than from 22-k. gold of

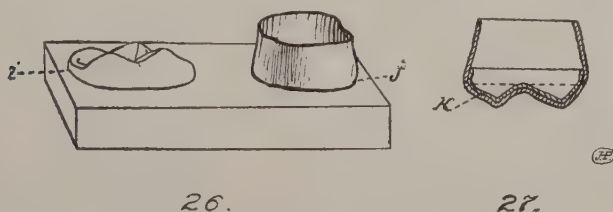


PLATE 237.

equal thickness. Therefore, in order to have the needed bulk of platinum in the occlusal surface of a crown to withstand attrition, two thicknesses of platinum are swaged, separately at first, and then together and solidly attached by soldering.

This is necessary since the interior of such crowns cannot be reinforced with solder, as is done in ordinary crownwork, as it would be more or less dissipated by the heat necessary to fuse the porcelain.

647. Special care should be taken to contour the peripheral margin of the band and the corresponding margin of the cusps until they coincide perfectly, then true both contact margins, first with a flat file and following this by dressing on an oil stone until perfect contact is secured, thus obviating the use

of much solder in attaching the two pieces together (Plate 237).

648. The method of constructing a crown of this class in the ordinary manner and afterward swaging a second piece to the interior to stiffen up the occlusal surface, allowing the margins of the second piece to overlap the joint between the band and cusp, is frequently resorted to with satisfactory results.

649. To give additional strength to the crown at the point where the saddle and truss bars join it, a second piece of platinum plate is often adapted and soldered to this surface, on the outer side of the crown.

The caps and crowns having been constructed and fitted in their respective places, an accurate bite and an impression are secured, the models constructed, and mounted on an occluding frame.

Construction of Saddle.

650. The saddle, although not universally, is frequently used to give the porcelain proper contour on both labial or buccal and lingual surfaces.

Formerly broad saddles were recommended and much used, but it was noticed that when constructed in this manner the lodgment of food was invited and as its removal was difficult it became a source of annoyance on account of the odor engendered.

Saddles, therefore, when indicated, should be as narrow as possible, yet sufficiently wide to fulfill the requirements of proper contouring of the case.

651. The position as well as outline for the saddle can be best determined by waxing the facings in position and trimming the wax to correct form, then marking on the model the line thus indicated. Another method frequently followed is to make the saddle broader than necessary, and after the first application and baking of the body, cut away the surplus margins. This gives good results, but entails considerable waste of material.

652. The saddle should lap well over caps and against crowns to insure secure attachment of the several parts. It is cut to proper length and width as indicated by the outline on the model, and either burnished and conformed to the model, or a Melottes metal die secured and it is swaged.

Where much irregularity of surfaces, on which it is to rest, exists, the latter method is an excellent and accurate one.

653. When swaged or conformed perfectly, it is attached to the caps and crowns by soldering and the several connected parts are fitted in the mouth for final adjustment of the saddle to the natural tissues. A large round end burnisher or one of the contra-angled form designed by the author can be used for this purpose. The saddle should be pressed uniformly against the soft tissues until a slight blanching of the gum is noticeable. This should disappear in three or four minutes and the tissues regain their normal appearance. Too great pressure will produce hypertrophy of the tissues and finally atrophy and absorption, while under a properly adjusted saddle they will remain in a healthy condition and in contact with it.

654. At this time the partially constructed framework is in position in the mouth, and the soft tissues in a more or less compressed condition. If removed and placed on the original model the saddle would be distorted, since the model, unlike the gum tissue, is unyielding. Therefore it becomes necessary to take a new bite and impression, and mount the models as before.

Locating and Fitting Truss Bars.

655. In short spans a single bar of 16 or 15 gauge round iridio-platinum wire is usually sufficient to furnish the needed rigidity and support to the bridge. Longer spans frequently require two bars of 16 gauge or a single bar of 14 gauge.

656. The position for the truss bar is found by grinding the facings accurately to place and waxing them in position. Varnish the outer surface of the model with separating medium and pour a matrix of plaster against the labial or buccal surfaces of the teeth and model. When set remove from the model and if the facings have remained with the framework remove and place them in their respective positions in the plaster matrix.

The wax is all removed and the plaster matrix carrying the teeth returned to the model. The truss bar is then bent and conformed to the lingual surfaces of the facings usually occupying a position between the pins and the ridge lap. By placing in this position more space is afforded for the porcelain

and the liability of its breaking away under stress will be much less than if the bar was placed between the pins and the occlusal or incisal margins of the facings.

657. Broad surface contact should be secured between the bar and posts and the several parts held in absolute contact while soldering, so as to insure the greatest possible amount of strength.

The attachment of the bar to a shell crown is usually made by splitting the abutting end and adapting the split portions

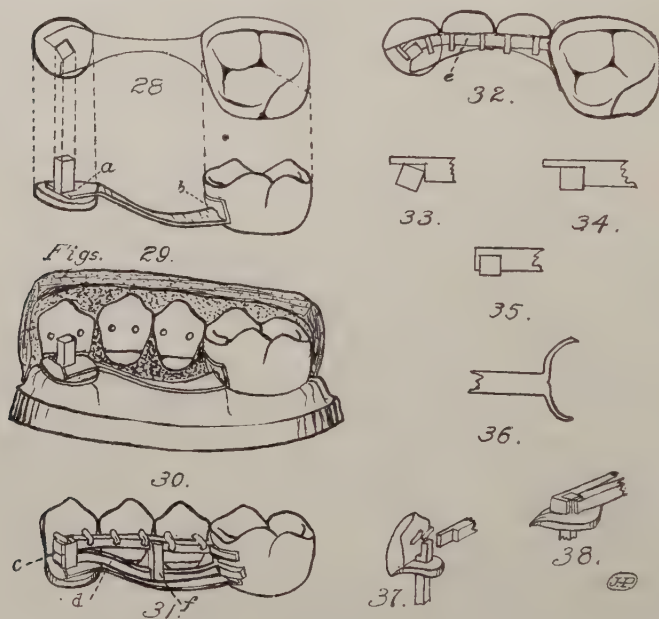


FIG. 238.

to the reinforced section of the crown before mentioned; or a hole may be drilled through the axial wall of the crown and the bar bent so as to pass up the inner side of the wall and across the occlusal surfaces a groove being cut in the tooth if necessary for the accommodation of the bar. This affords a firm anchorage to the crown and one that will not pull away as frequently occurs when the contact of the bar with the crown is insufficient.

658. Round or oval are preferable to square bars since the

sharp angles on the latter seem to induce the beginning of fracture in the porcelain, under stress.

If square wire is used the sharp angles should be rounded off to obviate this difficulty.

659. When the bar is accurately adapted, the ends are waxed to the posts and crown attachments.

660. In the series of drawings shown in Plate 238 the construction of a two-bar truss of square wire is illustrated. In Fig. 31 *d* the bar next to the saddle is first fitted and attached to cap, pin and shell crown. The second bar nearest the occlusal surface is next fitted, bending it so as to lie in close contact with the lingual surfaces of the facings as shown in Fig. 32 *e*. It can be bent to pass over the pins if necessary, but when possible should pass under them, for reasons before stated. It can be bent irregularly to follow the line of the pins, should they be uneven. The ends of the bars connected with the posts can be notched as indicated in Fig. 34 and the reduced portion bent around the post as shown in Fig. 35.

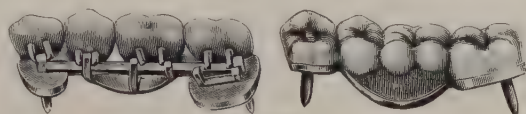


FIG. 239.

Fig. 239 *a* shows a single bar truss, with short posts soldered on the molar cap and at intervals along the truss bar, to afford firmer attachment to the lingual body of porcelain.

Fig. 239 *b* shows the piece after the porcelain has been applied and baked.

661. Fig. 33 shows imperfect contact of post and bar; Fig. 37, a condition in which there is not space enough between the labial side of the post and the lingual surface of the facing to receive the truss bar, and, to overcome the difficulty, both post and bar are notched. In some cases both bars lie on the same side of the post, one upon the other, as indicated in Fig. 31 *c*, and again there are cases where if arranged in this manner, the outer one would be thrown too far occlusally. One is then placed on the lingual side of the post and the other one on the opposite side, as in Fig. 38.

662. In Fig. 36 the method of splitting the bar and bending the split ends so as to partly encircle the shell crown is

illustrated. When bicuspid and molar roots carry full porcelain crowns the bars are attached to their caps and posts in the manner described.

The bars, when fitted, are connected by braces which are cut and accurately fitted in position. Both ends can be notched as shown in Fig. 31 *f*.

663. The several parts having been accurately fitted they are waxed together, the facings removed, the cap, crown, saddle and truss removed from the model and invested so that the investing material extends over the bars and holds them firmly in position after the wax is removed. When soldered the frame is returned to the model and the facings returned to place, waxed in position, the piece removed again, invested, the pins, after having been flattened, bent in actual and close contact with the bar and soldered. Pliers shown in Fig. — are useful for this purpose.

664. The essential points to be observed in constructing the framework for a porcelain bridge are:

First, be accurate in every detail. Second, make close and accurate joints. Third, flow solder into and between all joints so as to perfectly unite the several parts together.

Soldering.

665. In the construction of the platinum framework for crowns and bridges a platinum solder should be used for connecting the several parts together. That composed of 25 per cent platinum and 75 per cent pure gold is very difficult to melt with the ordinary gas blowpipe. The gasoline blowpipe shown in Fig. 242 or the alcohol blowpipe illustrated in Fig. 233 will either of them accomplish this work satisfactorily.

666. The objection to the use of pure gold as a solder is due to the fact that in the high temperature necessary to fuse porcelain, the gold forms an alloy with the platinum, of a crystalline character, which so changes the nature of the latter that it breaks very readily under stress. Another objection is that if all of the gold is not thus dissipated it is volatilized in baking the porcelain, and as it passes outward through the body it causes porosity in the porcelain.

Application of the Body.

667. Before applying the porcelain body the framework should be pickled, cleansed and roughened on those surfaces

against which the porcelain is to be fused to afford some additional attachment of the porcelain to the metal framework.

As mentioned in connection with crownwork a pin vice can be used to good advantage in handling the piece while applying the body.

668. The body is built on the lingual surfaces of the facings and against the saddle a little at a time, and the piece vibrated to settle the granules of powder close together, the moisture is taken up as it appears on the surface and a rough contour given the piece for the first baking.

669. All particles of body should be removed from the labial or buccal surfaces of the facings, for if carried through the furnace they become attached and can only be removed by discing or grinding, which destroys the fine glaze on the porcelain.

Baking the Porcelain.

670. In introducing porcelain of any variety or class into a furnace it should be carried in gradually so that all moisture may be expelled slowly. If carried in too rapidly the steam generated in the interior of the body will, in escaping, cause it to flake away, sometimes to a very considerable extent.

671. The first baking should be carried far enough to produce a slight glaze on the surface of the porcelain. When carried to this point but little further shrinkage will occur in subsequent bakings, unless at such times the piece is overfused. The porcelain will be more or less cracked and shrunken after the first baking and the cracks should first be compactly filled with body before building up or adding to the general contour.

672. Two or three bakings are usually required to complete the bridge, although even a greater number are sometimes required to complete some cases. It is a noticeable fact that where a piece has been subjected to the furnace a number of times repeatedly, more or less porosity is apt to develop in the body of porcelain, sometimes so noticeably as to require an entire reconstruction of the porcelain work.

The fewer times the case is subjected to the furnace heat the better will be the quality of the porcelain.

673. The carving of the cusps on the occlusal surfaces should be carried out in a clear, sharp and well-defined man-



FIG. 240.

ner, because some of the details are lost, sharp lines being rounded down and definite grooves being partially filled in, in fusing.

674. An intensely high temperature, greater than that required to fuse pure gold, is required to fuse high fusing porcelain bodies. Improved types of furnaces in which high temperatures may be easily attained are available for this work.

675. Fig. 240 shows the Custer electric furnace of large size, suitable for baking anything from an inlay to a full continuous gum denture. The use of the large furnace of this type for very small work is not recommended for the reason that the wear in such work is equal to that where full cases

are constructed, while smaller and much less expensive furnaces, will accomplish equally as good results, and in case of accident can be repaired at much less expense than the large oven.

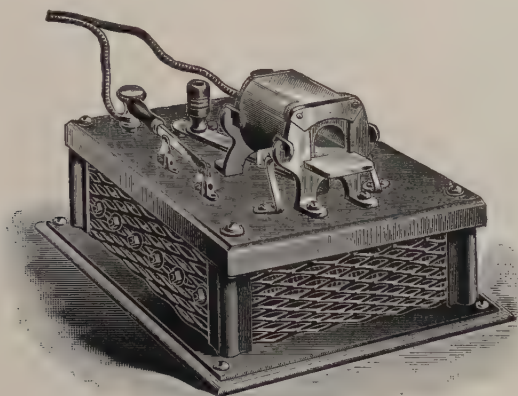


FIG. 241.

676. Fig. 241 shows a cut of the Hammond electric furnace, suitable for inlays, crowns and large bridges.

Fig. 242 illustrates the Turner gasoline furnace, suitable for inlays, crowns and small bridges. This is intended more

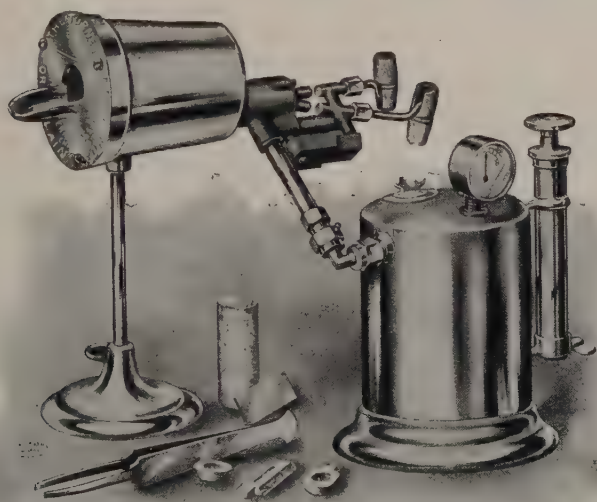


FIG. 242.

especially for use in locations where the electric current is not available, although many prefer this type of furnace to the electric oven.

677. Other forms of electric, gasoline and gas furnaces are procurable which are, perhaps, as satisfactory as those illustrated, but as cuts are not at hand to illustrate them they are not here shown.

Setting Porcelain Bridges.

678. The instructions in regard to setting ordinary crowns and bridges (see paragraph 510) is applicable to porcelain substitutes. It is best, whenever possible, to use gutta-percha instead of cement in this operation for reasons mentioned in a former chapter.

CHAPTER XXVI.

Continuous Gum Dentures.

679. Of the many classes of dentures now constructed none equal, in æsthetic requirements and cleanliness, those composed of porcelain and which are known as *continuous gum dentures*.

They are made in various ways, usually with a base-plate of platinum, to which the teeth are attached, first by soldering the single long pins, with which they are furnished, to the plate, and afterward fusing to the base and around the teeth a silicious compound known as "continuous gum body." This body is composed of kaolin, feldspar and silix, in varying proportions.

These ingredients also form the basis of porcelain teeth, but are mixed in such proportions as to fuse at a much higher temperature than the continuous gum body, so that in fusing the latter, in denture construction, the teeth may not be fused.

Origin of the Word Porcelain.

The first importations of china ware into Europe were made by the Portuguese, who gave it the name "Porcelain," from its resemblance to the nacre, or lining, of the sea shells, Porcellana (Cyprea).

The sea shells of this species derive their name from Porcus (a hog), from their supposed resemblance to the back of this animal.

The Portuguese supposed that porcelain was made from pulverized eggshells, fish scales and fish glue.

680. *Kaolin* is a fine, pure variety of clay, and is an aluminum silicate. It is formed by the disintegration and decomposition of granitic and feldspathic rocks by weathering or by continued freezing and thawing. These rocks, being granular, take up moisture, and this, when expanded by freezing, splits off the outer surfaces. The rain in time dissolves out certain constituents and washes away the small particles,

which, as they are carried down the stream, grind upon each other and become still more finely divided until all semblance to their original form is lost. These particles, mixed with sand, float or are carried down the stream and settle in beds. Some of these clay beds are high above the water line, having been deposited thousands of years ago and placed in present locations by volcanic upheavals.

The word *Kaolin* is a corruption of the Chinese *Kauling*, meaning a *high ridge*, and is the name of a hill near Jachau Fu, from which a great deal of this material comes.

A fine variety of clay also comes from Germany, and this, as well as the Chinese clay, is used quite extensively in the manufacture of porcelain tooth bodies.

The clay is prepared for use by mixing with water in a tank, agitating and allowing the sand and heavier particles to settle and drawing off the water while the finer particles of clay are held in solution.

These are allowed to settle in the second tank, and the water, when clear, is carefully drawn off and the clay allowed to dry. The slab of clay is then turned over, and any sand that may be present is scraped away, when it is ready for use.

Feldspar.

681. Feldspar is a double silicate of aluminum and potassium. It occurs crystallized in rhombic prisms. There are many varieties of this mineral, but only those that are free from soda or lime are used in porcelain work.

Feldspar, suitable for tooth bodies, is found in many parts of the United States, but the principal deposits suitable for this purpose are near Wilmington, Del.

It is yellowish in color and quite free from deleterious substances.

It is prepared for use by burning in a furnace, after which the larger pieces are broken up with a hammer and ground to powder in a wedgewood mortar. The powder is then run through a No. 10 bolting sieve, placed in closed vessels and kept dry, ready for use.

Silica.

682. This mineral is a silicic oxide, and is ordinarily known as quartz. It is one of the constituents of granitic

rocks, and it also occurs free in large masses in many parts of the United States. It is prepared for use by grinding to a fine powder in a powerful mill constructed for this class of work. It is extremely hard and practicably infusible.

These three materials (kaolin, feldspar and silix), as before stated, are combined in varying proportions to form the tooth body and the more fusible continuous gum body.

Properties of the Basic Constituents.

683. *Kaolin* imparts plasticity to the tooth body before baking, thus enabling it to be molded into the desired form. It also contracts somewhat in baking, and as a result binds together the more infusible ingredients.

684. *Silix*, owing to its infusibility, keeps the teeth or body from fusing down and losing form in the heat of the furnace.

685. *Feldspar* imparts translucency and also acts in the nature of a flux, closely uniting the clay with the silix.

686. The following is one of Dr. E. Wildman's formulæ for tooth bodies:

No. 1.	Kaolin	1 oz.
	Silix	3 ozs.
	Feldspar	18 ozs.
	Titanium oxide	65 grs.

The formulæ for continuous gum bodies are not published by the manufacturers, but they are similar to those of tooth bodies, except that more feldspar and Kaolin are added to reduce the fusing points. Continuous gum body, when fused, is of a white to yellow color, depending on the amount of oxide of titanium present, this being added to impart the yellowish tinge.

The gum body, when fused around the teeth and over the plate, gives the form to the denture. This is then covered with a thin layer of gum enamel, which, when glazed, imparts a pink tinge, resembling the natural gum tissues.

Gum enamel is made by combining certain compounds in certain proportions with feldspar. These compounds are known as frits and fluxes, the formulæ of which are as follows:

687.	No. 2 flux.	
	Carbonate of potassium.....	1 oz.
	Fused borax (powdered).....	1 oz.
	Quartz	4 ozs.

This is fused, then crushed and ground to a fine powder.
Gum frit is made by taking:

688. No. 3. Purple of Cassius..... 16 grs.
Feldspar 700 grs.
Flux (as per formulæ No. 2). 175 grs.

This is fused, pulverized and ground to powder. The pink enamel is then made by combining gum frit and feldspar in the following proportion:

689. No 4. Gum frit (per formula No. 3)...1 oz.
Feldspar 3 ozs.

This also is fused, crushed and ground fine, when it is ready for use.

Fortunately, the body and enamel can be purchased, already prepared for use, of any of the supply houses. From these formulæ, as given, perhaps a vague idea can be formed as to the amount of study and effort it has taken to develop this particular specialty and bring it to its present exactness.

690. About 1800 a French dentist, by the name of Delabarre, began the construction of porcelain dentures, but as his colors were crude, his system of manipulation imperfect, and because of the extremely high temperature at which the body fused (3,761 degrees F.), the method did not gain in favor very rapidly.

To Dr. John Allen of New York belongs the credit of having first successfully constructed dentures of this class. This was about fifty or fifty-five years ago, and since that time a number of men have given their time and energy to the development and construction of this class of work, and have in many instances given to the dental profession the results of their efforts, so that to-day continuous gum dentures, among the many classes of plates constructed, stand without a rival.

691. The only objection that can be validly urged against them is their cost to the patient. The materials that enter into the construction of such a plate cost but little, if any, more than those in a gold denture. The expense lies in the fact that very much more time and skill is called for in the construction of dentures of this class than in any other. Someone has aptly said that "all works of art should bear a price

commensurate with the amount of time, energy and skill expended in their production."

This is most certainly true of any dental operation where the functions of mastication are restored, but it should especially apply to those cases where, in addition to restoring these functions, the facial contour is also restored, and by a class of substitutes that on account of their beauty, cleanliness and similarity of color to the natural tissues defy detection.

Construction.

692. The first step in the construction of a continuous gum denture, after taking the impression, is to form the model, secure the die and counter-die and swage the base-plate as outlined for gold bases. Pure platinum (No. 28-g.) should be used. When swaged it is trimmed and fitted in the mouth.



FIG. 243.

693. Around the buccal and labial margins is soldered a triangular wire, against which the body will be finished. The end of this wire should terminate about the middle of each tuberosity, as indicated in Fig. 243*a*. A small wire (about 26-g.) is abutted against the ends of this larger wire and laid in, in a pleasing curve, so that in the central palatine portion

it is advanced 5 or 6 mm. in front of the distal termination of plate *b*. Over this smaller wire is swaged a piece of 30-gauge platinum plate (*c*), the anterior margin of which should pass over and terminate on the anterior surface of the wire (see Fig. 244*a*). This is now soldered down to the base-plate, and the anterior margin of both plate and wire is dressed, as indicated at *b*. The distal margin should be ground off to terminate in a feather edge (*c*).

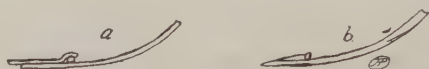


FIG. 244.

694. A wax rim is built upon the base-plate and the bite secured, as already outlined. The teeth are then occluded and arranged as the facial contour demands and the wax melted around the pins so as to firmly hold the teeth in position. The wax is removed from the labial and buccal surfaces, as well as from the embrasures, in order that the investment may entirely cover these surfaces of the teeth and hold them firmly in position.

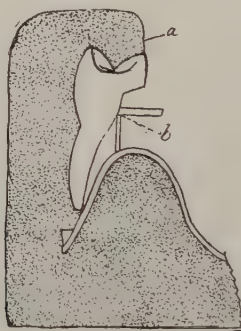


FIG. 245.

695. The investment is now mixed, filled into the palatine surface of the plate and extended beyond the sides and carried up over the occlusal and incisal ends of the teeth (Fig. 245*a*). When set the wax is entirely removed from the lingual surfaces.

696. The pins should be bent out nearly straight and a strip of platinum cut and fitted under the pins so as to stand edge-

ways, one edge coming up in close contact with the pins and the other resting on the plate, as indicated in Fig. 245*b*. The pins are now bent down in contact with strip and plate (Fig. 246). Platinum solder is cut in small pieces and placed at point of contact of each pin with strip, and of the strip with the plate.

697. The case is dried out over a Bunsen flame, and when in condition the blowpipe flame is directed upon the investment until this is heated to a bright red. This insures expansion in the porcelain before that in the platinum pin occurs, and thus obviates the checking of the teeth.



FIG. 246.

698. The solder should be perfectly fused and the pins, strip and base-plate firmly united. If the teeth are imperfectly united to strip or plate they very frequently change position during the fusing of the body—an accident that is extremely annoying as well as difficult to rectify. After soldering, the case is allowed to cool slowly, and the investment removed.

699. It is then pickled and washed to remove all impurities and placed back upon the model on the occluding frame to verify the position of the teeth. It is a good plan to try in the mouth if possible and study the amount of restoration necessary. The surface of the platinum to be covered by the porcelain is now scratched with a sharp-pointed instrument to afford some anchorage for gum body to the plate.

Application of Body.

700. It seems hardly necessary to state that in this operation, as well as in many others in prosthetic work, the table,

instruments and hands should be scrupulously clean. If any dust or impurity becomes incorporated with the body it will most certainly cause a discoloration of the latter when fused.

The instruments used in this step are two slabs or shallow dishes—one for holding the body, and the other the enamel. Some clean linen napkins, one or two camel's-hair or sable brushes and one or two carving tools.

701. The body is placed in the dish and distilled water is added in sufficient quantity to make a moderately stiff paste. Some of this paste is now taken upon the blade of the carving tool and placed around and under the pins and the plate tapped at some point to settle the granules closer together. As the moisture appears on the surface it can be removed by pressing a napkin or bibulous paper against the paste. More is now added and the process repeated until the plate has been built up to perhaps two-thirds of its required bulk. Usually the gum portions are not fully developed at this time, this being left until the second application.

702. Care should be taken to remove any body that may be present on the surfaces of the teeth not designed to be covered by the material.

Brushes are used for dusting away the body from these surfaces. The case can be dried over the Bunsen flame by passing it back and forth a few times and thoroughly warming it through.

Gum arabic or tragacanth are sometimes used to unite the granules together, though their presence is not essential, so that any carving that is necessary to do may be carried out without the body crumbling away. The case is now ready for introduction into the furnace.

Furnaces.

703. The most common form of furnace used to-day is one in which the heat is produced by the passage of the electric current through a fine platinum wire. The wire is disposed around the interior of the furnace, slightly imbedded in the clay lining or wrapped around the muffle which receives the pieces to be baked. Fine platinum wire offers an enormous resistance to the passage of a current, and the effect of this resistance is shown by the heating of the wire (see Fig. 240).

A temperature of 2,500 to 2,700 degrees F. could probably be attained in some of the furnaces now on the market. This high temperature is unnecessary for ordinary baking purposes, as Close's and bodies of that class fuse at about 2,050 to 2,300 degrees F.

Baking the Body.

704. The case is introduced in the furnace and the current turned on. This is usually controlled by passing it through the rheostat so that the heat may be gradually applied. The lever of the rheostat is carried from one connection to the other, allowing it to rest upon each one about the same length of time. Usually about 15 to 20 minutes will be consumed in turning the current on full force. After this about 10 or 12 minutes are required to bring the case up to the point of fusing the body. A very good test of this is to place a pellet of pure gold on the slab on which the case is resting.

Since pure gold melts at 2,016 degrees F., and as the body fuses at 2,050 degrees F., then, by continuing the heat in the furnace for one or two minutes after the gold has melted, the temperature can be carried to the fusing point of the body.

705. The body should not be glazed during the first baking, but carried to the point of fusing of the feldspar and yet stopped before the granular surface is entirely lost. This stage is called "biscuiting." Usually one accustomed to baking can readily tell by the color of the heat in the furnace just how far the baking has progressed, and can stop it at the proper time. After turning off the source of heat the case is allowed to cool down gradually, for if the current of cold air should strike it when heated checking is apt to occur.

706. The body will be found to have shrunken to a greater or less extent, usually about one-fifth, and the thicker portions to have cracked considerably. These cracks are first filled up and then the entire case rebuilt at all points necessary, with more body, developing fully its proper contour and restoring or building up the gums to the required form. Should it be deemed best to develop the rugæ, and it usually is, it should be done at this time.

707. The case is then baked the second time, carrying the heat up this time sufficiently to glaze the surface very slightly. Should any cracks appear during this baking, and

yet the general contour of the case be correct, so that no more body need be added, the fractures may, if small, be filled with the gum enamel while distributing this material over the plate and thus avoid a third baking of the body alone. The enamel is applied in the same manner as the body, but in a thin layer only, the object being to tinge the entire surface of the denture, except the teeth, a pink color. Since enamel fuses at a lower temperature than the body, the current should be turned off as soon as the surface is glazed. If overheated it begins to assume a glassy appearance and becomes more or less bleached as well.

When baked, if found perfect and free from cracks or air holes, it is ready for finishing. Sometimes a second baking of enamel is necessary, and when so it should be conducted as carefully as the first and stopped at just the proper point to insure a glazed surface.

Finishing.

708. The finishing of a case is accomplished with stones and discs in the engine, cutting away and polishing the metal parts of the base wherever necessary. If properly constructed the *porcelain* will not require cutting or polishing at any point.

These dentures, when made by a master hand, are the most beautiful and natural-appearing substitutes that human skill has yet produced, and no time nor pains should be spared nor be considered too great when spent in acquiring the skill necessary to construct dentures of this class.

Among the pioneers of the West in this class of work may be mentioned Dr. L. P. Haskell, of Chicago; the late Dr. H. H. Keith, of St. Louis, and Dr. George Field, of Detroit, whom it has been the writer's good fortune to have known, more or less intimately, for a number of years, and to whom he is indebted for many valuable hints on this subject.

CHAPTER XXVII.

Porcelain Inlays.

709. The term "inlay" in its dental application means the construction and fitting of a tooth filling or cavity stopper, consisting of one piece of some dense material, to a cavity prepared to receive it.

710. It is interesting to note the early efforts, the progress, and the development, from ancient times down to the present, of the inlay methods of filling the natural teeth.

The teeth of the mummies from the ancient tombs and pyramids of Egypt, and from the catacombs of Italy furnish abundant evidence of the fact that inlays as well as other classes of fillings were used in very early times.

The aborigines of the western continent in a few instances were also familiar with this method of tooth preservation. A few years ago, Professor Owen found an ancient skull, at Copan Honduras, in the central incisors of which were inlays made of green stone.

711. A brief description of the history of inlay work, during the last century, may not be uninteresting since it shows the gradual evolution of the methods now employed. In 1902 Dr. W. W. Bruck of Breslau, Germany, in a paper entitled "The Filling of Teeth with Porcelain," gave a very good outline of the history of inlay work, a brief synopsis of which is here introduced.

712. To C. J. Linderer he gives credit for having described processes which were called *fournieren* (inlaying) and *plattieren* (veneering) of the teeth.

The *fournieren* process consisted in shaping rods from the teeth of animals, preparing the cavity in circular form, and tapping a rod of proper size into the cavity, the projecting portion being cut away and the end of the inlay reduced to the same plane as the tooth surface in which the cavity was situated. The expansion of the inlay, due to moisture, retained

it in place. He sometimes threaded both cavity walls and rod, and the inlay was screwed into place.

The *platieren* method was used for shallow cavities and consisted in shaping a small, flat piece of walrus or rhinoceros tooth to fit the prepared cavity. These inlays were sometimes held in place by small dowels of the same material.

The objection to these methods was due to the discoloration and destructibility of the materials employed, as well as to their lack of correspondence in shade to the natural teeth.

713. In 1837, Dr. Murphy of London used glass, by melting it in a platinum matrix shaped to the cavity, and securing the inlay thus formed, in the cavity, with amalgam.

714. In 1857, Dr. A. J. Volck recommended "the use of porcelain in filling cavities in front teeth," but the details of his methods are not given in Dr. Bruck's article.

715. In 1862, B. Wood recommended the use of porcelain, shaped by grinding to conform to the general outline of the cavity. The periphery of the inlay was slightly smaller than that of the cavity and into this space gold was packed, thus holding the porcelain in the cavity by wedging.

716. In 1870, Dr. Hickman filled large buccal and occlusal cavities in molars by reducing porcelain crowns or teeth by grinding, to accurately fit the cavities. They were held in position with oxychloride of zinc or gutta-percha.

717. About the same time, Dr. E. T. A. Starr recommended the use of prepared "cavity stoppers," small pieces of baked porcelain, variously shaped, sometimes carrying pins to assist in anchoring them in place. These were carefully ground to fit the cavity walls and retained as those just previously described.

718. In 1870, Dr. C. H. Land of Detroit began the first series of experiments of fusing porcelain in a platinum matrix adapted to the cavity. This is the essential principle of the method in vogue to-day for the construction of inlays from high fusing porcelain body. Only indifferent results, however, were attained at that time on account of the high fusibility of the porcelain employed, pulverized artificial teeth being used for this purpose.

719. In 1889, Dr. W. Storer-How described the process

of making inlays from artificial teeth, similar to the method recommended by Dr. Hickman.

720. In 1889, Dr. Herbst recommended the use of powdered glass, by fusing it into a matrix of plaster-of-Paris. The matrix was made by taking a modeling compound impression of the cavity and filling this with plaster, then removing the compound. This gave a reproduction of the tooth with cavity in plaster into which the glass was fused with a blowpipe.

721. In 1890, Professor Sachs recommended the construction of a platinum or gold foil matrix, burnished to the cavity, into which powdered glass was fused. This method was similar to the one recommended by Dr. Murphy in 1837. The objection to the use of glass was on account of its friability and the difficulty in matching the shades of the natural teeth. There was also a tendency to discolor after having been in use for a time.

722. For a number of years past the manufacturers of porcelain teeth have furnished cylindrical rods of porcelain, slightly tapering, of varying sizes and shades, for inlay purposes.

By this system the cavity in the tooth was prepared with a trephine or a wheel bur and consequently was circular in form. From a rod of correct shade and of a diameter corresponding to the cavity, a section was cut, slightly longer than the depth of the cavity, which was then cemented in place and the projecting end dressed down to correspond to the enamel surface in which the cavity occurred.

723. Inlays of this character are almost entirely limited to cavities in the labial surfaces of the anterior teeth, although they are occasionally applicable to cavities situated in comparatively flat surfaces, in bicuspid and molars that are easily accessible to trephine or bur.

Many other methods of inlay work might be mentioned which have been devised, recommended and practiced for a time, but which for various reasons proved impracticable or were found deficient in one or more essential qualities and have been abandoned.

Present Methods.

724. The system of inlay work most universally practiced at the present time consists in preparing the tooth cavity, con-

forming a matrix of platinum or gold foil to it, or to a reproduction of it, and flowing the inlay material into the conformed matrix.

725. Inlays may be divided into two classes, porcelain and metallic, each of which have their peculiar merits.

Like all classes of filling materials, porcelain has its advantages and disadvantages.

Advantages.

726. *First.*—With *care, skill and experience*, porcelain inlays may be so accurately constructed, and the shades of the natural teeth in which they are placed so perfectly matched, that it will be impossible to detect these restorations from the natural tooth structure except by the closest scrutiny.

The esthetic properties of this material, therefore, place porcelain above that of any other filling material for the artistic restoration of the natural teeth.

727. *Second.*—Porcelain is not a good conductor of heat and cold, and for this reason inlays can be placed in cavities of teeth that are sensitive to thermal changes where metallic fillings could not be tolerated.

728. *Third.*—Patients are not subjected to long and tedious sittings in the chair. This is a great advantage in those cases where the patient is of a decidedly nervous temperament and is physically unable to undergo tedious filling operations.

729. *Fourth.*—The strain upon the operator is less than in filling operations.

Objections.

730. *First.*—It is asserted that the means of attachment of the inlay to the cavity is unreliable, and will in time invite the lodgment of food and the consequent recurrence of caries.

This assertion is based on the fact that cement is most commonly used for this purpose, and since all dental cements are more or less soluble in the fluids of the mouth, that between the periphery of the inlay and the cavity walls is gradually dissolved, leaving a space in which food may enter.

731. The enthusiastic inlay operator answers this objection by asserting that the cement in most cases is not dissolved out to any extent, but maintains its integrity for years. This is accounted for by the fact that inlays are, in most, and should

be in all, cases, set in the cavity under continued pressure while the cement is crystallizing. Pressure maintained during this period condenses the cement, rendering it much harder and more compact, and consequently more insoluble than when introduced without pressure. Those who have followed inlay practice for a number of years claim to have ample evidence to prove that recurrent decay does not often occur if the formation of the cavity and the construction and setting of the inlay are properly carried out.

732. It is supposed by some that the presence of the cement prevents the formation, or, at least, neutralizes the action of the acids resulting from the decomposition of food and that this may account for the non-recurrence of caries in those cases where solution of the cement has occurred, leaving a slight opening around the periphery of the inlay.

This objection to the use of the inlays will probably never be settled satisfactorily until some cement is found that will be insoluble in the fluids of the mouth.

733. Not one of the most enthusiastic porcelain operators maintains that a poorly constructed, ill-fitting inlay will be serviceable, but rather, will prove worthless as a tooth filling. They concede that an inlay, to be serviceable, must *fit the cavity* perfectly, especially at the cavo-surface angle, and have strong, well-defined and perfect margins. An inlay so constructed and set in its cavity under maintained pressure will require an almost inconceivably small amount of cement to retain it in position, and it is reasonable to suppose that the liability to recurrent caries is very slight.

734. Without doubt very many of the failures in this class of restorations are due to faulty construction and imperfect setting, and just in proportion to the thoroughness with which the various steps are carried out will porcelain inlays prove serviceable and lasting.

Friability.

735. Porcelain in thin, attenuated plates is friable and very easily broken.

Cavities involving an incisal angle or the occluso-proximal surface of a tooth should be so shaped that the inlay will have strong, well-defined margins and ample bulk to withstand the stress of mastication. When conditions pre-

clude the formation of cavities in this manner, porcelain is contraindicated.

The Shadow Problem.

736. One difficulty often met with in tooth restoration by the inlay method is that known as the *shadow problem*.

This refers to the tendency of porcelain to present varying shades when viewed from different angles or under the changing shadows of the lips.

A porcelain inlay is occasionally constructed that appears, when viewed from one standpoint, to match perfectly in color and be indistinguishable from the natural tooth in which it is set, but which, when viewed from a different angle or when the position of the lip is changed, is so modified in shade as to be very apparent and decidedly objectionable.

737. Dr. W. H. Reeves of Chicago states that he has overcome this very decided objection by baking the porcelain in layers of different colors, so that the direct absorption and refraction of light is broken up and the inlay will present the same color when viewed from any angle.

738. Sometimes an inlay, when placed in the tooth cavity previous to cementing it in place, will match the tooth perfectly in color, yet when permanently set the shade will be so modified as to be plainly noticeable.

This is due to the cement with which it is held in place preventing or cutting the absorption of the rays of light by the inlay.

739. A plan recommended by Dr. F. T. Van Woert of Brooklyn, N. Y., to partially obviate this difficulty is to etch the periphery and pulpal surfaces of the inlay with hydrofluoric acid.

The face of the inlay should be protected with a film of wax to prevent the action of the acid on this surface. This accomplishes two purposes; first, it prevents a change of color due to the cement; second, the etched surfaces afford the cement a firmer attachment to the porcelain. This, however, does not always obviate the former difficulty.

740. Formerly when porcelain bodies of low fusibility, more nearly partaking of the nature of glass or jewelers' enamels, were used for inlay purposes, the tendency to discolor after being used in the mouth for some time was very marked.

This was due to the presence of some of the salts of lead or of the alkalis in the inlay material, which in time dissolved out.

This objection has disappeared since the advent of the higher fusing porcelain bodies of the present day, since these contain none of the substances mentioned.

Difficulty Met With in Construction.

741. One of the most decided objections to the use of porcelain inlays, in addition to those already mentioned, is the delicate technical skill that must be acquired in order to do this work successfully. It has been stated by some one that a *higher order of skill* is necessary for inlay construction than in other operative or prosthetic procedures. This may be true to a certain extent, but the difficulty lies in the fact that very few of those who undertake this class of work have given it the same amount of thought or familiarize themselves with the materials employed to the same extent that they have in general operative or prosthetic procedures.

742. Anyone with an average amount of skill and patience can, if he will, acquire the necessary dexterity to do this class of work successfully. A beginner should not attempt difficult restorations until familiar with the more simple cases. In this, as in any other class of technical procedures, skill comes with practice and patient application.

High and Low Fusing Porcelain Bodies.

743. At the present time two classes of porcelain bodies are in general use; first, *high fusing*, or those that require a temperature greater than that necessary to melt pure gold, to vitrify them, and *low fusing*, or those that vitrify below the melting point of pure gold.

The following table gives the approximate temperatures at which the well-known bodies and enamels vitrify:

Consolidated tooth body.....	2630° F.
S. S. White's tooth body.....	2515° F.
Dental protective tooth body.....	2440° F.
Justi's tooth body.....	2440° F.
Sibley tooth body.....	2410° F.
White's porcelain	2300° F.

Close's body	2300° F.
Ash's tooth body.....	2260° F.
Whiteley's porcelain	2210° F.
Brewster's body	2210° F.
Consolidated high fusing.....	2200° F.
Brewster's enamel	2080° F.
Moffit's porcelain	2050° F.
Copper	1980° F.
Gold	1950° F.
Ash's high fusing.....	1900° F.
Downie's	1550° F.
Jenkins'	1550° F.
Ash's	1550° F.
Brewster's low	1500° F.

The above figures were taken from a temperature scale recently designed by Dr. W. A. Price of Cleveland, O., to be used in conjunction with an electric furnace of his own device.

744. In Chicago and the middle West the S. S. White new inlay material and Brewster's body and enamel are the principal high-fusing bodies, and the Jenkins, the principal low-fusing porcelain used.

High and Low Fusing Porcelain.—Advantages and Disadvantages of Each.

745. Porcelain operators are divided in opinion as to the relative merits of these two classes of bodies. It is claimed that high-fusing porcelain is stronger; that it will *retain its color better* in fusing, and when permanently set in the mouth; that it is as easy to manipulate as low fusing, and that it can also be used for crown and bridge purposes; that perfect color results can be secured on account of the large variety of colors furnished, which may be used separately or blended, as the case requires.

746. Those favoring the low-fusing porcelain, while admitting that it is not so strong as the high-fusing porcelain, claim that it is strong enough for inlay and crown purposes; that it is easier to manipulate; that *better color results* can be secured in matching the shades of the teeth than with the high-fusing porcelain, and that it will retain its color perfectly when permanently set.

The differences of opinion above noted are undoubtedly largely due to lack of familiarity with the bodies under consideration. Time and use alone will determine the relative merits of each.

Without doubt for most purposes the high-fusing bodies will prove most satisfactory and permanent for general purposes.

Preparation of Cavities.

747. While the formation of cavities for the reception of porcelain inlays is similar, in a general way, to those prepared for other filling materials, there are some points of variation of such importance that they cannot be overlooked without failure resulting.

These points of variation will be mentioned and emphasized from time to time in the following description of cavity preparation.

Cavity Walls.

748. The walls of cavities should be formed as nearly parallel to each other as conditions will permit. True parallelism of the walls cannot be secured because it would not be practicable to remove the matrix from a cavity with parallel walls without distortion of the former occurring. It is, therefore, necessary to give the walls of cavities a slightly divergent relation to each other extending from the pulpal or axial walls outward.

749. Hereafter, when the term *parallel walls* is used in this description it will mean walls which are *approximately* parallel to each other and yet are sufficiently divergent to permit the ready removal of a matrix without distortion.

750. The general rule that *cavity walls should be approximately at right angles to the surfaces in which they are located* can be followed with safety.

It will seldom be possible, except in flat surfaces, to so shape a cavity that all its walls will be parallel, but an effort should be made in all cases to secure parallelism of at least two walls to aid the cement in retaining the filling in position. Matrices can be more readily conformed to and removed from cavities with widely divergent walls, but inlays set in such cavities are readily displaced.

751. This method of shaping cavities with flaring walls was

formerly practiced to a considerable extent, but for two reasons has been abandoned.

First.—Because inlays set in such cavities were more or less easily displaced.

Second.—The extreme beveling of the cavity walls necessarily reduced the inlay at the cavo-surface periphery to a frail, delicate edge easily broken in the removal of the matrix or in setting with cement. Where the line of junction of the inlay and cavity walls occurred on an occlusal surface the margins would break away under the stress of mastication.

752. Cavities occurring on occlusal surfaces should, when practicable, have the cavo-surface angles of their walls laid beyond the points of contact or occlusion with the opposite teeth. This will greatly reduce the liability of margins to fracture under stress, a point of much importance in the restoration of incuspsids and molars.

753. The cavo-surface angles of cavities cannot be beveled to the same extent for porcelain inlays as they should be where metallic fillings are to be inserted for reasons before mentioned, viz., the resulting frail margins to the inlay when constructed.

To the conscientious operator, who invariably planes the enamel walls of cavities to insure full length enamel rods in this location, the foregoing plan seems erroneous, and one which if followed out would in time result in defective enamel margins.

754. It must be remembered, however, that when an inlay is properly set, under pressure maintained while the cement is crystallizing, the minutest space between the cavo-surface angles and the periphery of the inlay is filled with condensed cement. This supports both cavity margins and those of the inlay, and since the condensed cement maintains its integrity much better and solution occurs more slowly than when introduced as an ordinary filling, it is reasonable to suppose that enamel margins though only slightly beveled will stand for a reasonable length of time.

Depth of Cavities.

755. The depth of cavities in most cases depends upon the extent to which caries has progressed except where extension

for prevention has been made and in cases where the teeth are affected with superficial caries or erosion. In all cases the cavities should be carried through the enamel and sufficiently far into the dentine to furnish good anchorage and give necessary bulk for strength to the porcelain.

Locations Favorable to the Use of Porcelain.

756. Porcelain is indicated in cavities exposed to view where proper retention can be secured and the fillings when constructed will have sufficient bulk to withstand stress.

The classification of cavities, ranging from those in which porcelain is most strongly indicated to those in which it is least required, may be stated as follows:

First.—Simple labial or buccal cavities.

Second.—Cavities in the six anterior teeth not involving the angles.

Third.—Cavities in the anterior teeth involving the angles.

Fourth.—Cavities in bicuspid and molars involving an axial and an occlusal surface.

Fifth.—Occlusal cavities in bicuspid or molars.

Preparation of Cavities.

Labial Cavities.

757. In cavities of this class, as well as in all others, the principles of *extension for prevention* should be carried out as fully as possible.

Undermined enamel should be broken down and the cavity outlines made symmetrical.

The walls should be as nearly parallel as conditions will permit to insure retention of the filling.

758. In surfaces where much curvature exists a parallel condition of the walls may be secured, partially at least, by squaring out the dentine slightly below the dento-enamel junction.

759. The angle formed by the junction of the axial with other walls should not be squared out too definitely.

760. The cavo-surface angles should be sharp and well defined and but slightly beveled, if at all, in order that the peripheral margins of the inlay will not be frail.

Cavities in the Six Anterior Teeth Not Involving the Angles.

761. In cavities of this class it is necessary to separate the teeth before beginning operations. These cavities must be formed without undercuts. They should be so shaped that the matrix when burnished in position can be removed without distortion. The location of the cavity will determine the direc-

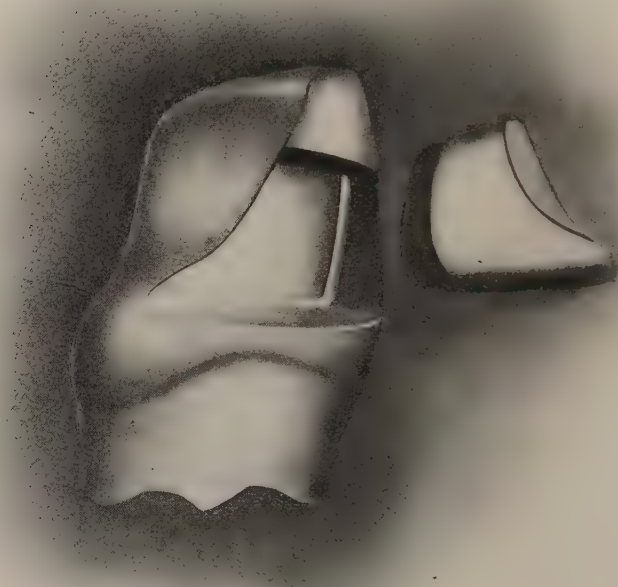


FIG. 247.

tion in which the matrix can be most readily removed, whether labially or lingually. If the cavity of decay has progressed more to the labial than to the lingual, the cavity preparation should be made to allow the removal of the matrix labially. If decay has progressed to a greater extent lingually, the preparation of the cavity should be made accordingly to meet this condition (see Fig. 247).

762. The gingival and incisal walls should be made as nearly parallel to each other as practicable. When the cavity is formed for the introduction from the lingual side the labial margin should be carried far enough labially to insure the porcelain being well exposed to view. This will partially obviate the *shadow problem* that arises in this location. The cavo-surface angles should be prepared as outlined in cavities of the previous class.

Buccal Cavities.

763. The preparation of cavities of this class is similar in most respects to those of the first class mentioned, and the rules there laid down apply with equal force to the class under consideration.

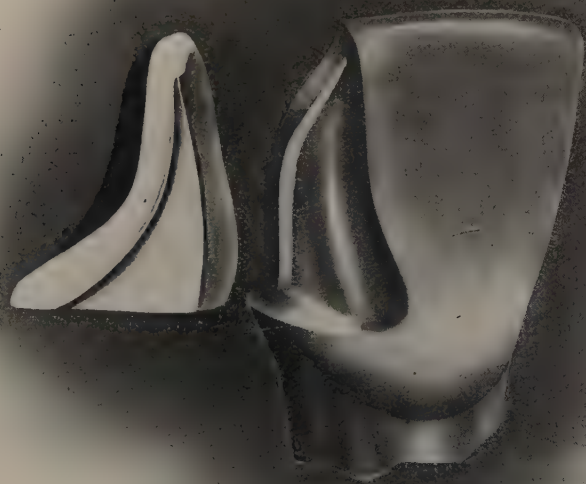


FIG. 248.

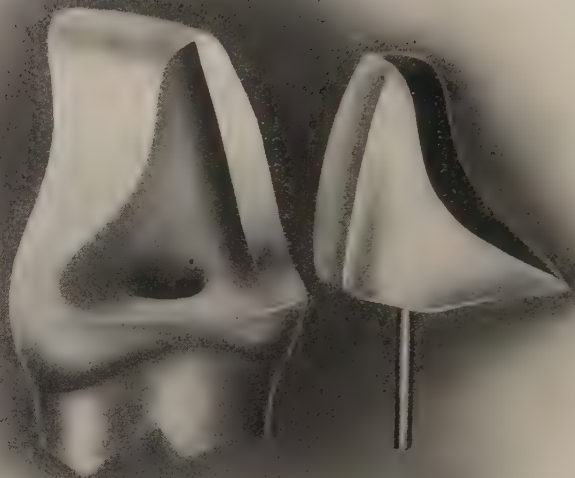


FIG. 249.

Fig. 245 illustrates a cavity prepared as directed and the inlay baked around a post which extends into the root canal, thus furnishing additional anchorage. Note that there is a labial shoulder to prevent outward displacement.

Proximal Cavities in the Anterior Teeth Involving the Angles.

765. The preparation of cavities of this class requires much thought and skill, since the completed fillings are exposed to a greater or less amount of stress in mastication.

766. The gingival wall or seat should be made flat and at right angles to the long axis of the tooth.

The introduction of inlays in cavities of this class must naturally be in a labial, lingual or incisal direction, therefore the

labial and lingual cavity walls must be formed at least parallel with the long axis of the tooth.

767. In the upper anterior teeth, when the cavity does not extend far on the labial surface, preparation can be made as follows:

Square the gingival wall. Cut away the labial and lingual walls to permit of the ready removal of the matrix. Cut a step



FIG. 250.

on the lingual surface of the tooth, extending from the incisal edge to the gingival wall.

This is done by removing a section of the lingual plate of enamel, as shown in Fig. 248.

Cut a groove at the junction of the linguo-axio-mesial or distal walls, as the case may be, extending from the gingival wall to the incisal edge, and bevel the several cavo-surface angles slightly.

It is usually best to cut away the labial plate of enamel at the incisal edge to the same extent that the lingual has been carried back (see Fig. 248) to avoid a long irregular line of junction occurring on the incisal edge.

Cavities in Bicuspids and Molars Involving an Axial and an Occlusal Surface.

768. The same general principles followed in the preparation of cavities for the reception of gold or amalgam fillings applies in inlay work with a few exceptions, which will be noted (see Fig. 250).

First.—The cavity must be formed without undercuts.

Second.—The axial, buccal and lingual walls should be slightly diverged, from gingival to occlusal, to allow the ready removal of the matrix in an occlusal direction.



FIG. 251.

Third.—When the line of junction of the cavity wall and the periphery of the inlay comes within a contact area of a tooth in the opposite jaw, it invites the fracture of both margins. Therefore cavity walls should be laid beyond such points of contact to prevent stress on the periphery of the inlay.

Fig. 251 represents a method of restoring the angle of an incisor tooth. The cut shows a lingual view of the cavity, with the inlay rotated to the left. The labial shoulder, flat seat and slight groove in both seat and shoulder furnish needed resistance to displacement. The preparation for lower incisors should be reversed.



FIG. 252.

Fig. 252 illustrates a method of restoring a notched incisal edge. A lingual view of the cavity is presented. The shoulder prevents outward displacement. In lower incisors the shoulder should be prepared in the labial plate to prevent lingual displacement by the upper teeth.

The preparation of the cavities as outlined is similar in most respects to the methods recommended and taught by Dr. A. E. Peck, who deserves much credit for the interest he has displayed along this line. Those who are familiar with his system will note the points of difference as they occur.

Conforming the Matrix.

769. The conformation of the platinum foil to the cavity is a step requiring skill, patience and experience. Two methods are followed at the present time, both of which are reliable if proper care is exercised. The system most commonly followed consists in burnishing the foil directly into the cavity with pellets of cotton or spunk carried in the pliers and by the use of suitable burnishers of ordinary and special shapes.

The other method consists in swaging the matrix in an impression of the cavity or a model derived from an impression, with a suitable swaging device.

To secure the best results, the cavity margins should be finished with small, suitably shaped Arkansas stones (Fig. 255). The margins, when so finished, present sharp, well-defined angles, against which the inlay may be made to fit almost perfectly.

Burnishing the Matrix.

770. The rubber dam should be applied in all cases and the cavity dusted with soapstone to prevent tearing the foil.

A piece of platinum foil, thoroughly annealed, should be cut of sufficient size to extend beyond the cavity margins when pressed into place. This is centered over the cavity and held in position with the fingers, while a small piece of spunk carried in a pair of ball-pointed pliers (Fig. 254) is pressed against the center of the foil to force it against the floor of the cavity.

771. Special care should be taken to obviate the wrinkling of the foil against the cavity walls, to prevent its tearing while being forced to place, or its perforation by the pliers or burnishers. Wherever a wrinkle or fold appears it represents three thicknesses of foil at that point, and while the bulk of material

may be thinned down somewhat in burnishing, it cannot be reduced to any great extent. The result is that when the inlay is completed a very perceptible space exists where the fold occurred, which must be filled with cement. This is objectionable on account of the color of the cement and because of its ready dissolution under such conditions.

772. The foil, having been carefully forced to the floor of the cavity, is held there by a burnisher resting on a pellet of spunk. Another pellet is taken up with the pliers and forced into the cavity, carefully adapting the foil to the entire floor first, before making any attempt to adapt it to the walls.

773. The adaptation to the walls is secured by pressing a small pellet into the cavity near the floor and drawing it outward, producing pressure toward the wall at the same time. The entire floor of the cavity should be covered with spunk, held with some suitable instrument during the operation.

Some prefer to use various shapes of rubber points for this purpose, and very good results are secured in this way, but as the spunk and cotton are always conveniently at hand and pellets of any size can be formed quickly, these materials are perhaps more commonly used than the rubber points.

774. Burnishers of various forms may now be used to advantage to secure adaptation of the foil to the cavity walls and angles.

When fairly close general adaptation has been secured the entire matrix is filled with spunk and pressure applied with an instrument which will force the foil against the floor and walls of the cavity at the same time.

775. The adaptation of the foil to the outer surfaces of the tooth can be accomplished with spunk in the manner outlined, drawing the pellet from the cavo-surface angle outward in all direction until the foil lies flat upon the tooth surface.

776. The adaptation of the foil to the cavo-surface angle yet remains to be done. This is one of the most important steps in the whole operation. Securing perfect adaptation at this point, with sharp angle definition, without folds in the foil, insures practically perfect margins to the inlay.

777. The entire interior of the matrix should now be filled with spunk and a piece larger than the cavity applied over all. Pressure with a suitably shaped instrument slightly larger than

the cavity or with the finger, when this is possible, is made against the spunk to force the matrix into all parts of the cavity, against the cavity margins and the tooth surfaces at the same time.

The spunk should then be removed and the matrix lifted out, the surplus, if excessive, trimmed away and the foil thoroughly annealed and returned to the cavity for adaptation.

Necessity for Annealing.

778. When metal plate is swaged, hammered or burnished the relation of the molecules to each other is changed. This is especially true of platinum foil used in matrix construction. By repeatedly annealing and returning the matrix to the cavity for final adaptation the foil can be made to lie "dead flat" without change under heat, as suggested by Dr. W. H. Taggart.

779. Warpage of the matrix may also occur from the adhesion of the porcelain to the platinum during baking, owing to the contraction of the former in this step. By using foil of sufficient thickness for the matrix and applying the body properly, warpage during the vitrefying of the latter can be prevented, especially in fillings of ordinary size. In very large fillings baked blocks of high fusing porcelain may be ground in such manner as to support the margins of the matrix, the porcelain body being built around the block and baked.

780. The manner of applying the body to the matrix for the first baking is an important factor in preventing warpage, and will be explained later under proper heading.

The necessity for annealing and adapting the foil to the cavity several times before applying the body and baking should be firmly impressed upon the mind of the beginner in this work for reasons stated.

The annealing can be best accomplished by introducing the matrix into the furnace and subjecting it to as great a degree of heat as is required to fuse the porcelain.

Great care must be exercised in handling the matrix to prevent its distortion by the grasp of the pliers or in the application of the body.

Swaging the Matrix.

781. The cavity is first dusted lightly with talcum powder. A mix of Britton's cement of rather thick consistency is made

into which is incorporated sufficient talcum powder to destroy its adhesive property without impairing its plasticity. It should be thoroughly kneaded with the fingers to incorporate the talcum and render the mass uniform in consistency.

This is then introduced into the cavity, confined somewhat by a matrix, when necessary, and sufficient force applied to secure a sharp, definite impression of all necessary surfaces, and allowed to harden. Any surplus portions that would prevent the ready removal of the impression should be cut away.

The impression is then carefully loosened and removed. If it is thin and weak at points it should be strengthened by the addition of more cement after removal from the cavity.

782. The excessive overlapping of the margin should be cut away, leaving only a slight shoulder to indicate the cavity outline.

The impression is imbedded in a ring which forms a part of the swaging device. Cement, modeling compound, or plaster may be used for this purpose, the two latter preferably for economical reasons. The general surfaces of the impression should be above the level of the ring margin, so that the swaging cushion may force the foil against the impression at all points.

783. The cushion or counter-die usually consists of unvulcanized rubber, a soft rubber water bag or moldine, any one of which answers the purpose very well.

784. The opening in a matrix so constructed will represent the exact diameter of the cavity from which the impression was taken and an inlay baked in a matrix so formed will, if warpage does not occur, exactly fit the cavity, while by the burnishing method the inlay is the thickness of the foil smaller than the cavity.

Good results are secured by both methods given, it being a matter of choice or preference among porcelain workers rather than one of superiority of one method over the other.

Selection of Body of Proper Color.

785. The selection of porcelain body of proper color to harmonize with the tooth structure is one of the most difficult tasks for a beginner to undertake. A little experience, however, enables one to arrive at fairly accurate results.

786. The teeth are first closely examined while moist, and the various shades observable in the enamel and underlying dentine noted.

Usually yellows, grays and blues predominate, although browns, greens and greenish yellows are sometimes met with.

787. The dentine in almost all teeth is of a yellowish tinge, regardless of the color of the enamel overlying it. Therefore, in most inlays the base or foundation should consist of porcelain of a more or less pronounced tinge, according to the shade of the tooth. This is applied and baked first. Over this are laid the colors which coincide with those discernible in the teeth.

788. These should not be mixed indiscriminately, but laid on in exactly the position where that particular color should show. Sometimes two, three, or even four, colors may be required to reproduce the shades seen in the natural teeth.

789. When these have been properly placed and the piece vibrated to blend the several colors at their margins the second baking is carried out.

790. Over these colors is usually placed a final layer of neutral or semi-transparent gray tinted body and the final baking completed.

The underlying colors, although quite pronounced, are so softened down and modified as to harmonize with those in the teeth if the proper selection and application have been made.

791. The outline just given is that recommended by Dr. W. T. Reeves, whose contributions to the literature on this subject are quite valuable.

This method applies more particularly to the use of Brewster's bodies and enamels, which fuse at different temperatures, rather than to the use of bodies of varying shades, fusing at the same temperature, such as the S. S. White's porcelain crown and bridge body.

792. In handling the latter the same general plan can be carried out as that already outlined, with the exception that there is no neutral enamel to apply as a final finish, and, therefore, care must be observed to blend the colors nicely before introducing the piece in the furnace. Good color results may be secured with either variety if sufficient skill in manipulating them is acquired.

793. In proximal cavities it is necessary to construct inlays

of several shades lighter material than the color of the tooth seems to call for on account of the layer of opaque cement cutting off the rays of light and darkening the porcelain.

794. In selecting colors the samples furnished by the manufacturers with each outfit serve as guides in determining the colors in the natural teeth. The number or letter on each stick indicates the bottle, numbered in like manner, which contains porcelain powder of similar shade.

Application and Baking of the Body.

795. The proper color having been selected, a portion of it is placed upon a clean glass or porcelain slab, distilled water added and the mass thoroughly spatulated. The excess of water, if any be present, is taken up with a linen napkin, bibulous or blotting paper.

The matrix should be grasped lightly, but firmly, by the surplus margin with a pair of pliers that can be closed and set in order to insure against dropping the matrix.

A little of the moist body is taken up on the point of a spatula (see Fig. 250) and placed on the floor of the matrix. A serrated instrument is drawn over the pliers, or they may be tapped lightly to settle the particles of body closely together.

796. The thinnest possible layer of body is applied entirely over the inner surface of the matrix and baked the first time to obviate warpage.

797. The first baking should be continued until the porcelain is fully glazed, to induce the maximum shrinkage in the inlay and give an unchangeable base on which to apply additional layers of body.

The second application of body should be made in a similar manner to the first, being careful to condense it thoroughly by vibration. At this time the body should be built up against the walls of the matrix to perhaps half the depth of the cavity when the latter is large, and nearly full if quite small.

798. The second baking is carried to the point of glazing the body. The matrix with the partially completed inlay is returned to the cavity to note whether warpage has occurred, and, if so, to correct by additional burnishing.

799. The third application of body is now made, the matrix filled slightly fuller than the required contour and the body



FIG. 253.



FIG. 254.



FIG. 255.

around the margins trimmed to the exact angle, allowing no surplus to extend over the margin at any point.

Upon baking the third time, should the margins of the inlay be below the required level, additional body should be added and the case returned to the furnace. The last baking should produce an even, uniform glaze on the inlay surface.

In some cases, as in the occluso-proximal cavities of bicusps and molars, it will be best to divide the first, and, possibly, second, application of body with a thin spatula so as to allow the porcelain to separate in baking. This will prevent warpage of the matrix, which would be most certain to occur were this precaution not taken.

800. Occasionally bubbles will appear around the margins of the inlay and sometimes through the body of porcelain. These are due to imperfect condensation of the body, to impurities that may have been accidentally introduced or to overheating in the furnace. The way to avoid such mishaps is apparent.

Removal of the Matrix.

801. The matrix should be carefully removed to prevent fracturing the margins of the inlay. This is done by peeling it away from the inlay margins, using extreme care not to touch the peripheral angle with the fingers or instrument. Should the matrix tear, a sharp chisel can be used for prying up the edge of the foil, when it may again be stripped off.

Hydrofluoric acid is used to etch that portion of the inlay which is enclosed in the cavity, to give the cement a better hold upon the filling, and also to reduce the liability of shadows in certain locations. During this step the outer surfaces should be protected with wax to preserve the glaze.

The use of a knife-edged stone for cutting grooves in the inlay to give additional retention to the cement is recommended. In most cases, however, this is unnecessary when the cavity surfaces of the inlay are etched.

Setting the Inlay.

802. *First.*—Apply the rubber dam and dry the cavity.

Second.—Mix cement of proper color to moderately thin consistency and spatulate thoroughly.

Third.—Spread a thin, even layer over all portions of the

inlay to be enclosed in the cavity and carry it to place quickly, using all the force that is permissible to expel any surplus, and force the inlay to proper position before the cement hardens.

803. A strip of rubber dam may be placed over the inlay and around the tooth and stretched in such manner as to produce pressure upon the filling in the proper direction.

Pressure should be maintained for ten or twelve minutes until the cement has thoroughly hardened. When set the surplus can be trimmed away with sharp knives.

804. Usually an inlay, when first set, will appear darker than the tooth on account of the lightening of the latter, due to drying out preparatory to setting. The tooth after a time regains its normal amount of moisture and the inlay should harmonize perfectly in color with the tooth if the various steps have been properly carried out.

805. It is usually best to use a cement lighter rather than darker than the tooth because of the tendency of the inlay to assume a darker shade when set permanently in the cavity.

Fig. 253 represents a pair of ball-pointed pliers suitable for carrying the spunk or cotton into the cavity. The danger of puncturing the foil in this operation is thus obviated to a great extent. Fig. 254 represents a carving tool which is very useful in the manipulation of porcelain.

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647. Describe manner of waxing teeth in position	694
648. Give details of investing the case for soldering	695
649. What additional support for the teeth besides the contact of the pins with base-plate should be supplied?	696
650. Give details of soldering the case	697
651. What is liable to occur if teeth are not firmly attached to base-plate and strip in soldering?	698
652. How is the case prepared to receive the body?	699
653. Mention instruments and accessories and state the conditions necessary to the proper application of body	700
654. Give details of applying the body	701 and 702
655. What produces heat in an electric furnace?	703
656. What temperature is it possible to attain in furnaces of this type?	703
657. Describe the baking of a case	704
658. What is the <i>gold test</i> ?	704
659. What appearance does the surface of porcelain body have when "bisected"?	705
660. What precaution should be observed after the heat is turned off?	705
661. What condition is the body in after the first baking?	706
662. What treatment is given the case after the first baking?	706
663. Describe the completion of case prior to the final polishing.	707
664. Give details of finishing case	708

CHAPTER XXVII.

665. What is the meaning of the term inlay in its dental application?	709
666. What can you say of the origin of this class of work?	710
667. Describe the two methods of inlay practice credited to C. J. Lin- derer	712
668. What method was followed by Dr. Murphy?	713
669. Describe the Wood's method of filling teeth with porcelain.	715
670. Describe Dr. Hickman's method	716
671. What method was recommended by Dr. Starr?	717
672. Who began the system of inlay practice which is really the method in vogue to-day?	718
673. Describe the How method	719
674. What method was followed by Dr. Herbst?	720
675. Describe the Sachs method	721
676. What was the objection to this method?	721
677. Describe the system of making inlays from porcelain rods	722
678. To what class of cavities are inlays of this character limited?	723
679. Describe briefly the method of inlay work followed to-day.	724
680. Into what two classes are inlays divided?	725
681. Mention the several advantages of porcelain as a filling material.	726, 727, 728 and 729
682. Mention the objections to the use of porcelain inlays	730
683. What effect has maintained pressure on cement while setting?	731
684. Is recurrent caries frequent around the margins of inlays?	732
685. What are the conceded necessary requirements of an inlay?	733
686. To what may many of the failures in inlay practice be attributed?	734
687. What can be said as to the friability of porcelain?	735
688. What do you understand by the "shadow problem"?	736
689. What plan is followed for partially overcoming this defect?	737
690. To what cause may the change in color of a perfectly shaded inlay be due, when permanently set in the tooth?	738
691. What method may be followed for partially overcoming this objec- tion?	739
692. What causes low-fusing porcelain to discolor in the mouth?	740
693. Is this tendency noticeable in high-fusing bodies?	740
694. Mention one of the most decided objections to inlay construction	741
695. Where does the real difficulty lie?	741
696. Is the objection a valid one?	742
697. What two classes of porcelain bodies are used at present?	743
698. What is meant by <i>high-fusing</i> and <i>low-fusing</i> bodies?	743
699. Give the fusing points of the standard porcelain bodies	743
700. What two varieties of bodies are used mostly in the West?	744
701. What claims are made for the high-fusing bodies?	745
702. What are the advantages claimed for the low-fusing bodies?	746
703. To what may the differences of opinions be largely due?	746

704. Are cavities for porcelain inlays prepared the same as for metallic fillings?	747
705. In shaping cavity walls what relation should they bear to each other, when practicable?	748
706. Give the general rule in regard to cavity walls and the surfaces in which cavities occur	750
707. In what class of cavities is it possible to carry out this plan fully?	750
708. What objection is there to shaping cavity walls in a widely divergent manner?	750 and 751
709. How should cavities occurring on the occlusal surfaces have their margins placed?	752
710. Why does the plan recommended of leaving full length enamel rods at the cavo-surface angles of cavities seem erroneous?	753
711. How is this apparent fault compensated for?	754
712. What plan should be observed in regard to the depth of cavities?	755
713. State the five locations mentioned favorable for the use of porcelain	756
714. Give the essential points to be observed in the formation of labial cavities	757, 758, 759 and 760
715. Give the details of cavity preparation of cavities in the six anterior teeth not involving the angles	761 and 762
716. What can be said in regard to the preparation of buccal cavities?	763
717. Describe in detail the preparation of cavities in the anterior teeth involving the angles	765, 766 and 767
718. Describe the preparation of cavities in bicuspid and molars involving an axial and an occlusal surface	768
719. What two methods may be followed in securing a matrix?	769
720. Describe in detail the burnishing of a matrix to a cavity	770-777
721. Why is it necessary to anneal the matrix?	778
722. To what other cause may warpage of the matrix be ascribed?	779
723. How may annealing be best accomplished?	780
724. Give the details of securing a matrix by the swaging method	781, 782, 783 and 784
725. How may the proper shade of porcelain to use be determined?	785, 786 and 787
726. How are the several colors applied?	787, 788, 789 and 790
727. What is the difference in application of the Brewster and White's porcelains?	791 and 792
728. What can be said as to the shade of porcelain to use in proximal cavities?	793
729. What serves as a guide in selecting body of proper shade?	794
730. Describe the application of body to matrix for first baking	795
731. How thick should be the first application?	796
732. How far should the first baking be carried?	797
733. Describe the application and baking of the second addition of body	798
734. Describe the third application and baking	799
735. What should be the condition of the margins at this stage?	799
736. What is the occasion of porosity around the margins or through the body of porcelain, as sometimes occurs?	800
737. How may this difficulty be overcome?	800
738. Describe the removal of the matrix	801
739. Why is the use of hydrofluoric acid recommended?	801
740. Is it necessary to cut grooves in the inlay for retention purposes?	801
741. Give the details of setting an inlay	802
742. Why is the use of a strip of rubber dam recommended in this step?	803
743. Why is it that when an inlay is first set it will appear darker than the tooth?	804
744. Does this apparent defect usually disappear? If so, why?	804
745. Is it usually best to use a cement lighter rather than darker than the tooth, and if so, why?	805
746. Would a transparent cement, in your opinion, obviate this difficulty, and if so, why?	805



